ARI Research Note 90-131

Behavioral Variability, Learning Processes, and Creativity

Marc N. Richelle

University of Liege

Office of Basic Research
Michael Kaplan, Director

September 1990

United States Army
Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

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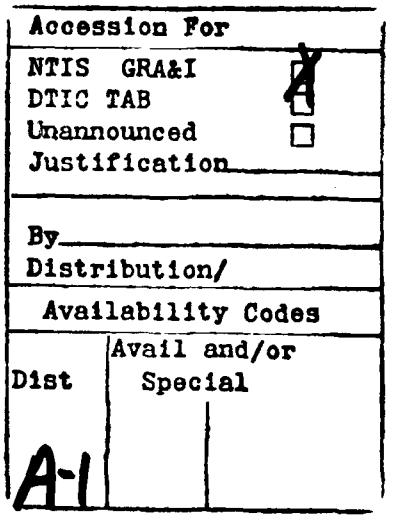

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

a. REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS --
a. SECURITY CLASSIFICATION AUTHORITY --	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
b. DECLASSIFICATION/DOWNGRADING SCHEDULE --	
. PERFORMING ORGANIZATION REPORT NUMBER(S) --	5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Note 90-131
6a. NAME OF PERFORMING ORGANIZATION University of Liege Belgium 6b. OFFICE SYMBOL (If applicable) --	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute
6c. ADDRESS (City, State, and ZIP Code) 5 Bd Du Rectorat, Campus Univ. Du Sart - Tilman, 400 Liege, Belgium	7b. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences 8b. OFFICE SYMBOL (If applicable) PERI-BR	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DAJA45-85-C-0038
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 61102B; PROJECT NO. 74F; TASK NO. N/A; WORK UNIT ACCESSION NO. N/A

11. TITLE (Include Security Classification)
Behavioral Variability, Learning Processes, and Creativity

12. PERSONAL AUTHOR(S)
Richelle, Marc N.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Interim	FROM 87/02 TO 89/05	1990, September	138

16. SUPPLEMENTARY NOTATION
Contracting Officer's Representative, Michael Kaplan

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Learning Cognitive flexibility reinforcement Visual

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This research investigated properties of behavioral variability in humans. Two categories of independent variables were considered: environmental and cognitive. The investigation suggested that the capacity to vary behavior is limited by the subject's general developmental level, which cannot be confounded with her/his cognitive capacities. The research concluded that variability is an inherent characteristic of behavior.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Michael Kaplan	22b TELEPHONE (Include Area Code) (202) 274-8722 22c. OFFICE SYMBOL PERI-BR

DD Form 1473, JUN 86 *Previous editions are obsolete.* SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

BEHAVIORAL VARIABILITY, LEARNING PROCESSES, AND CREATIVITY

CONTENTS

BEHAVIORAL VARIABILITY, LEARNING PROCESSES, AND CREATIVITY

AIMS OF THE RESEARCH AND CHOICE OF TASKS.

The present research is specifically aimed at investigating properties of behavioral variability in humans and at elucidating underlying mechanisms. Two main categories of independent variables are dealt : environmental and cognitive factors. We study their interactions with behavioral variability as a function of development (ontogenetic approach).

1.1. Environmental factors.

We want to analyse the influence of several reinforcement contingencies and visual feedbacks, on behavioral variability.

The task used is a new version, for human subjects, of the Visual Matrix (VM) technique, borrowed from Vogel and Annau (1973). This experimental situation is of course only one of the many situations, that could be designated to study behavioral variability, the common characteristic of which should be to provide for a wide range of various behaviors. It is essentially a simple problem solving task, with a number of possible solutions.

The device included a 4 x 4 light bulb matrix and 2 response-buttons. At the begining of a trial, before any response has been produced, all the lights in the matrix are off, with the exception of the upper left one. Any response on the left button has the consequence of switching off the light and simultaneously of switching on the next bulb to the right; any response on the right button similarly result in a displacement of the light one step from top to bottom. The trial is completed and reinforced when the light at the bottom right corner is on. A correct sequence is defined as a sequence in which the "goal" is reached after 6 responses - 3 on each button - in any of the 20 possible combinations. Every correct sequence is followed by a new trial. Any 4th response on a given button, after the extreme right or the extreme bottom has already been reached, terminates the trial and another trial is initiated. There are 30 possible incorrect sequences. Subjects are generally presented sessions of 50 trials.

Several authors have already used this version for humans, with

children (El Ahmadi, 1982) and with adults (Schwartz, 1982; Boulanger, 1983 and Wong and Peacock, 1986). In our research we adopt the principle of the matrix in an animate cartoon style, using a videoscreen controlled by a micro computer (detailed description can be found in the Method, pp. 12-13).

Three experimental situations will be investigated :

- the normal situation (matrix N) as described above.
- a situation in which the visual display does not give any usefull information (random displacement of visual cues) (matrix R).
- a situation that requires some variability to be reinforced (one sequence will be reinforced, only if it is different from the two previous ones)(matrix D).

By manipulating the reinforcement contingencies, the visual feedbacks and the presentation order of different experimental situations, we hope to define the subjects' spontaneous variability and its evolution with this task. We will try to answer the following questions :

- Does contingent reinforcement produce stereotypy, even when it is not required ?
- What is the role of visual cues ? Do they influence the sequence form ?
- Is it possible to induce behavioral variability ?
- Which role does play the subjects' experimental history, according to the situations they have been presented ?

We will compare these results according to age.

1 2. Cognitive factors.

Ontogenetic analysis as mean to understanding adult behavior need no special argument, after the demonstration of its usefulness by Piaget and others. It should help us in identifying more accurately crucial variables at work in behavioral variability in human subjects and in accounting for the strategies they use when confronted with multiple-solutions

problems.

Taking into account the evolution of the stages of the logico-mathematical thought, as described by Piaget and his collaborators, 4 age groups have been choosen :

- 5-6 y.o. subjects, at the pre-operative stage and coming from Nursery Schools.
- 9-10 y.o. subjects, at the concrete operative stage and coming from Primary Schools.
- 14-15 y.o. subjects, at the formal thought stage and coming from General Secondary Schools (no Technical School subject has been considered).
- Adults, students at the University.

Cognitive factors referred to here include the "mobility of thought", the hypothesis testing, the anticipation of outcome and the capacities of "abstractness". The choice of specific "cognitive" tasks has been determined by the possibilities to use at least one task with two successive age groups, and to adopt a standardized examination procedure. We have prefered the tasks with a concrete nature (we wanted to avoid too many verbal behaviors).

The following "cognitive" tasks have been selected according to the capacities they allow to assess :

- The seriation, the classification and the inclusion quantification tasks will permit to evaluate the cognitive stage (in the Piagetian nomenclature) of the 5-6 y.o. and of the 9-10 y.o. They will also allow to assess their mobility of thought determined by the different criteria number that the subject uses, successively or simultaneously to arrange the elements. The difficulty of the tasks is a function of the subject's age (simple multiplicative seriations; Level I Level II classifications).
- the serial classifications combine in a single situation, the operations of seriation and of classification, as approached in the classical Piaget's procedures. These tasks allow, following their authors (Botson and

Deliège, 1976) to eliminate the problems linked to the arbitrary nature of classifications, for a given material, there is here only one possible correct arrangement.

Two situations are possible : one where the perceptive impression corresponds to the system logic (perceptive serial classifications) and one where the perceptive impression conflicts with the reasoning (non-perceptive serial classifications). According to results already obtained with these tasks we have decided to use only the perceptive serial classifications with the 5-6 y.o. and with 9-10 y.o., and only the non-perceptive serial classifications for the 14-15 y.o. and the adults. We have selected a part of the available items.

The serial classifications will allow to complete the informations obtained with the Piagetian classification tasks (for Nursery, Primary and Secondary School subjects) and to assess the "abstractness" capacities and the "mobility of thought" of adults.

- the permutation task (Piagetian task of the formal logic) will be proposed to adolescents (14-15 y.o.) and to adults. It aims to assess the rule "abstractness" capacities. The rule generalization capacities and the capacities to use a systematic procedure in the search of all the possible permutations.

- The French version of the Group Embedded Figures Test has been chosen to differentiate the subjects, according to their field-dependence or independence. The "field-independent" cognitive style is determined by the subject's capacity to percieve one element independently of its context, and it is linked to the subject's capacity to adopt an analytic attitude in a problem solving task. This test will be proposed only to adolescents and to adults because there is no French version of it adapted for the children.

At the end of our analysis we will try to establish relations between the subjects' cognitive capacities, and their performance and their variability at the Visual Matrix task.

2. METHOD.

2.1 Subjects.

We have excluded, from an initial sample, subjects whose data could not be entirely used (recording errors or "testing" problems). We have kept data of some 5-6 y.o. subjects, whose "cognitive" data were unusable, because of the greater difficulties to obtain complete data with these young subjects. Finally, we have 368 subjects in our sample (variability) :

- 5-6 y.o. subjects : 79 subjects aged between 4.11 and 5.11 years (mean age : 5.5), coming from 5 nursery schools.

- 9-10 y.o. subjects : 91 subjects aged between 9.2 and 11 years (mean age : 9.9), coming from 7 Elementary Schools (4 th grade).

-14-15 y.o. subjects (adolescents) : 98 subjects aged between 13.1 and 15.8 years (mean age : 14.8), coming from 5 Secondary schools (3 th grade)

- adult subjects : 100 subjects aged between 18.3 and 24.7 years (mean age : 20.1), all students at the University of Liège.

In each age group, subjects have been, before experimentation, randomly distributed among five experimental groups, according the design presented below.

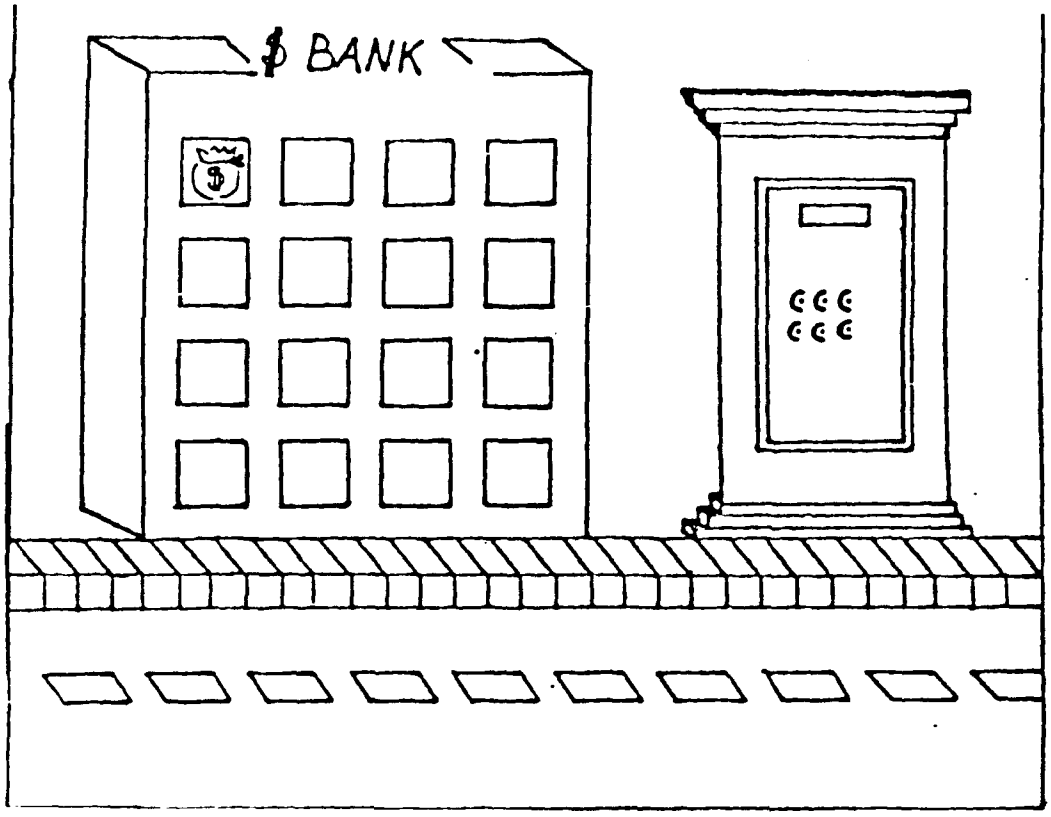
2.2. Materials and procedures.

Subjects have been seen individually three times, at about 24 hours intervals, in a room of their school.

2.2.1. Visual Matrix task :

The task is a new version, for human subjects, of the task borrowed from Vogel and Annau (1973).

The device includes a 4 x 4 matrix and two response-buttons. The matrix principle is adapted in an animate cartoon style, using a videoscreen, contolled by a microcomputer (Commodore 64).



The subject is presented with a bank building with four floors and four windows, at each floor. A moneybag is visible in the upper left window, at the biginning of the trial. Any response on the left button has the consequence of moving the bag to the next window to the right and any response ot the right button similarly results in a displacement of the bag one step from top to bottom.

The trial is completed and reinforced when the bag reachs the bottom right window. This means that the subject has produced a correct sequence of responses on the two buttons. A correct sequence is defined as a sequence in which the "goal" (bottom right window) is reached after six responses - three on each button - in any of the 20 possible combinations. No tolerance is made for "extra-responses" that is, any 4th response on a given button, after the extreme right or the extreme bottom as already been reached. In such cases, the trial is teminated and another trial is initiated (the moneybag appears in the upper left window). They are 30 possible incorrect sequences. Every reinforced sequence is also followed

by a new trial. They are separated by inter-trials intervals of 6,3 seconds (time between the last push on one button and a new possibility to begin a responses sequence)

When a sequence is correct, the bag falls into a wheelbarrow pushed by a securityman, who takes it to a safe. Each bag put into the safe adds one points to a counter and the safe fills up a little (always the same unity). If the sequence is incorrect, the bag falls into the wheelbarrow, but a thiefs arrives and takes it away.

The microcomputer records the responses as well as the times of realization and of latency.

Three different matrix types have been investigated :

1. Normal Matrix (N) : the matrix and reinforcement principles are those described above.

2. Random Matrix (R) : though the rules remain the same as for as sequences of responses are concerned, the visual display does not give any usefull information. After a response, the bag moves randomly to another window and no particular window is a "goal".

3. Normal Matrix with Differential Reinforcement (D) : the principles are the same as in N, except for the rule of reinforcement. A correct sequence is here reinforced if it is different from the two previous ones (correct or incorrect).

Five experimental groups have been formed from these matrix types :

Experimental groups	Session 1	Session 2	Session 3
1.	N	N	N
2.	N	R	N
3.	N	D	N
4.	D	R	N
5.	R	D	N

Each subject has been submitted to three sessions of 50 trials each (there is about 24 hours between the sessions). Subjects of our sample are distributed into the 5 experimental groups according to the following design :

AGE	5-6 Y.O.					
GROUPS	NNN	NRN	NDN	DRN	RDN	TOTAL
FEMALES	8	12	8	6	9	43
MALES	7	6	8	7	8	36
TOTAL	15	18	16	13	17	79

AGE	9-10 Y.O.					
GROUPS	NNN	NRN	NDN	DRN	RDN	TOTAL
FEMALES	10	10	9	7	9	45
MALES	10	8	10	10	8	46
TOTAL	20	18	19	17	17	91

AGE	14-15 Y.O.					
GROUPS	NNN	NRN	NDN	DRN	RDN	TOTAL
FEMALES	12	14	12	9	12	59
MALES	5	6	7	12	9	39
TOTAL	17	20	19	21	21	98

AGE	ADULTS					
GROUPS	NNN	NRN	NDN	DRN	RDN	TOTAL
FEMALES	8	10	6	7	8	39
MALES	13	10	14	13	11	61
TOTAL	21	20	20	20	19	100

Table 1 : Subjects' distributions in each age group, according to experimental group and to sex.

Subjects were told that their task was to store as many moneybags and to accumulate as many points as they can, by pressing the two buttons (one at once).

2.2.2. "Cognitive" tasks.

Besides the Matrix task, subjects have been submitted individually to tasks aimed at assessing their cognitive level, "mobility of thought" and cognitive style* : (detailed description of material, procedures and instructions for each task can be found in Annex, pp. 2-12)

A) Nursery school subjects : 4 tasks.

1. Simple seriation and intercalation.
2. Free, dichotomic and multiplicative classifications (level 1 : 3 criteria of dichotomy).
3. Inclusion quantification.
4. Perceptive serial classifications.

B) Elementary school subjects (4th grade) : 4 tasks.

1. Multiplicative seriation.
2. Free, dichotomic and multiplicative classifications.
   a) level 1 : 3 criteria of dichotomy
   b) level 2 : 6 criteria of dichotomy
3. Inclusion quantification.
4. Perceptive serial classifications.

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* The test aimed at assessing Field-dependent and Field-independent cognitive styles, has been proposed to adult and adolescents only because, at the experimentation time, there was no similar test adapted for children in French.

C) Secondary school subjects (5th grade) : 4 tasks.

1. Free, dichotomic and multiplicative classifications (level 2 : 6 criteria of dichotomy).
2. Non -Perceptive serial classifications.
3. Permutations.
4. Group Embedded Figures Test (GEFT)

(Field-dependent and field-independent cognitive styles).

D) Adult subjects : 3 tasks.

1. Non-Perceptive serial classifications.
2. Permutations.
3. Group Embedded Figures Test (GEFT).

3. RESULTS AND CONCLUSIONS

3.1. Visual matrix task.

Cues.

Ten cues have been selected to provide optimal information about performance and behavioral variability in the Matrix Task. Their values are calculated for each subject and for each session of 50 trials.

1. The percentage of correct sequences : **% C.S**.

2. The mean time of realization of one sequence : **MTR**.

A sequence begins with the first push and ends with the last push on one of the two response-buttons. Correct sequences and incorrect sequences are both considered.

3. The mean time of latency : **MTL**.

It's the time between the moment when a first lamp on the visual matrix is lighted on and the first push on one response-buttons, that initiates a sequence.

4. The uncertainty of sequences : **U(S)**.

This cue is derived from the Information Theory (Shannon and Weaver, 1948), that permits to estimate the information of a message Xi : ($I(Xi) = - \log_2 pi$), with pi being equal to the probability of occurrence of Xi in a set of messages : $X = \{ X_1, X_2, X_3, \ldots\ldots X_n \}$. The global "information" of the set of messages, called uncertainty U(X), is equal to the weighted sum of the information of the different messages :

$$U(X) = - \sum_{i=1}^{n} pi \log_2 pi$$

So we calculate the Uncertainty of sequences U(S) on the set of sequences produced by one subject during one session of 50 trials :

$$U(S) = - \sum_{i=1}^{50} pi \log_2 pi \quad , \text{with } pi = \frac{\text{sequence i frequency}}{50}$$

The unity of this cue is the bit, since logarithms are in base 2. U(S) is maximum if all sequences are equiprobable : U(S) = log2 50 = 5.64, ... It is 0, if only one sequence is emitted during the session. It 's use is to estimate the general degree of variability of the sequences in a session.

5. The number of different correct sequences : **NCS**. (0 to 20).

6. The uncertainty of correct sequences : **U(C.S.)**.

$$U(C.S) = - \sum_{i=1}^{20} pi \log_2 pi \quad . \text{with } pi = \frac{\text{correct sequence i frequency}}{\text{total number of correct sequences produced by the subject}}$$

7. The number of different incorrect sequences : **N(I.S.)**. (0 to 30).

8. The uncertainty of incorrect sequences : **U(I.S.)**.

$$U(I.S) = - \sum_{i=1}^{30} pi \log_2 pi \quad . \text{with } pi = \frac{\text{incorrect sequence i frequency}}{\text{total number of incorrect sequences produced by the subject}}$$

9. The percentage of the dominant sequence : **% D.S**

It's the sequence that is the most often emitted by a subject in a session. It can differ, for the same subject, from one session to another.

10. The number of correct sequences differing from the 2 previous ones (correct or incorrect). **NSD_2**.

It corresponds to the mode of reinforcement in the matrix D.

Means and standard deviations for each cue and for each experimental group, according to age and to session, can be found in Annex, pp. 17-26. (table 2 to table 11). Individual data are too large to be included in this report.

3.1.1. Effects of the factor age and of the factor session.

Results are presented here for each experimental group.

Analysis of variance (ANOVA : F) is completed by two other statistical analysis :

- Student t-test for related samples : comparing the evolution of each cue, according to the 3 sessions, for the same experimental group and the same age group.

- Student t-test independent samples : comparing the evolution of each cue, according to the 4 age groups, for the same experimental group and the same session.

3.1.1.1. Experimental group N.N.N. (see figures 1 and 2 , pp. 26-27).

- Performance :

In each age group, there is an increase of the %C.S., from the first to the third session. The 5-6 years old (y.o.) subjects obtain the lowest % C.S. in each session (significantly different only for the first session). Their performance progressively approachs this of the other age groups. The latter have, at once, very high levels of % C.S. (> 90%).

The inter-individual differences in the adaptation to the task are greater for the youngest subjects, as noted by the standard deviations (see Annex p.82-91, table 2 to table 11).

These seems to be a concordance between results obtained on realization times results on performance : MTR are significantly reduced between the first and the second session, for all the age groups. They are still decreased for the 5-6 y.o. during the last session. Generally, the youngests are the lowest and the adults, the fastest (for MTR and MTL).

- Variability :

Parallel to the increase of performance, we note an increase of sequences stereotypy, as globally shown by the cues that estimate the degree of sequences variability. This is especially marked from the first to the second session and for the first two age groups.

There is no significant difference between age groups, if we look at the variability of correct sequences. But we find a slight tendency for the 5-6 y.o. to be more stereotyped and for the 14-15 y.o. to be more variable. The youngest subjects use, on the contrary, more incorrect sequences and are significantly more variable than the other age groups.

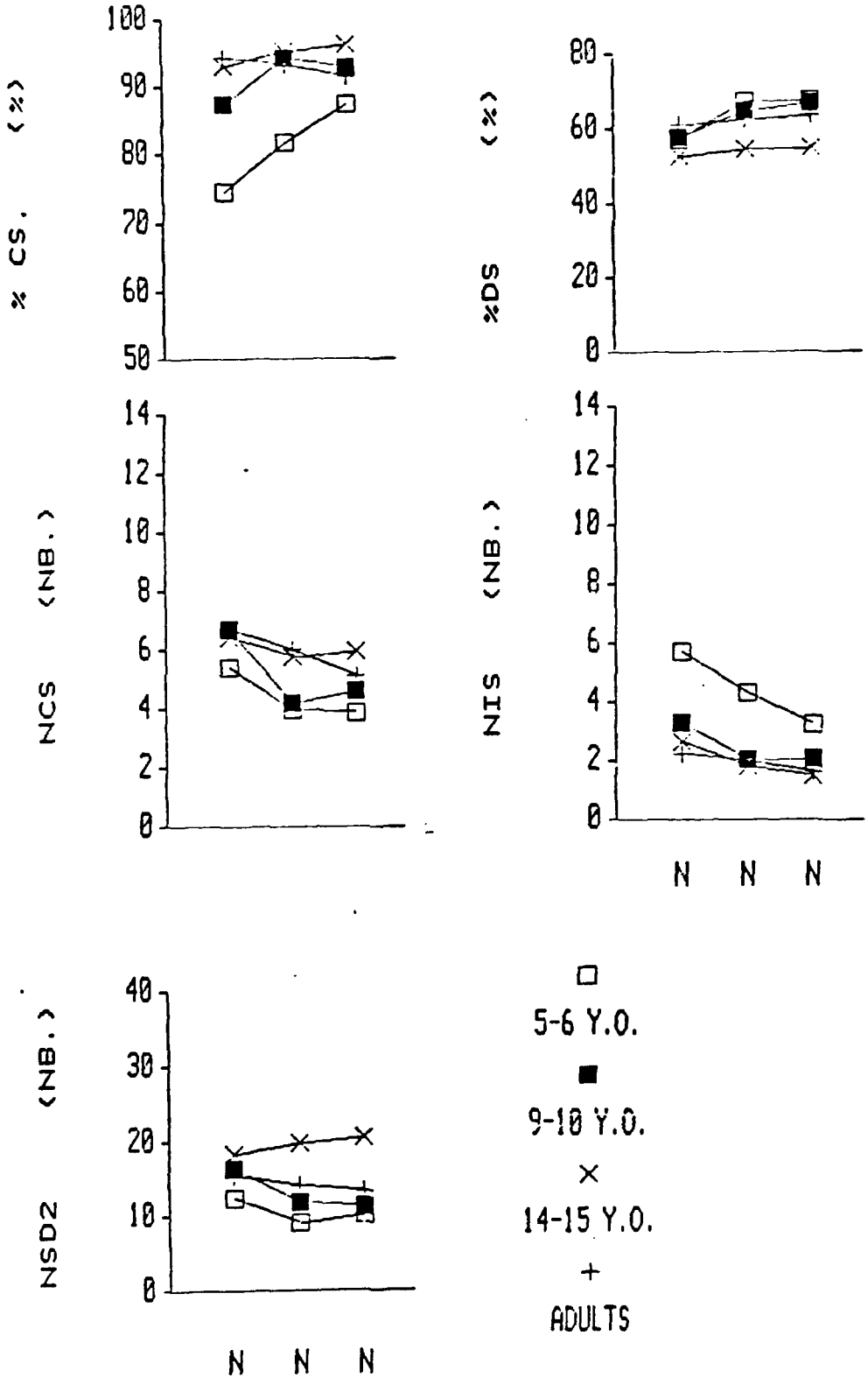

Fig. 1 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in each age-group, according to sessions of the experimental group NNN.

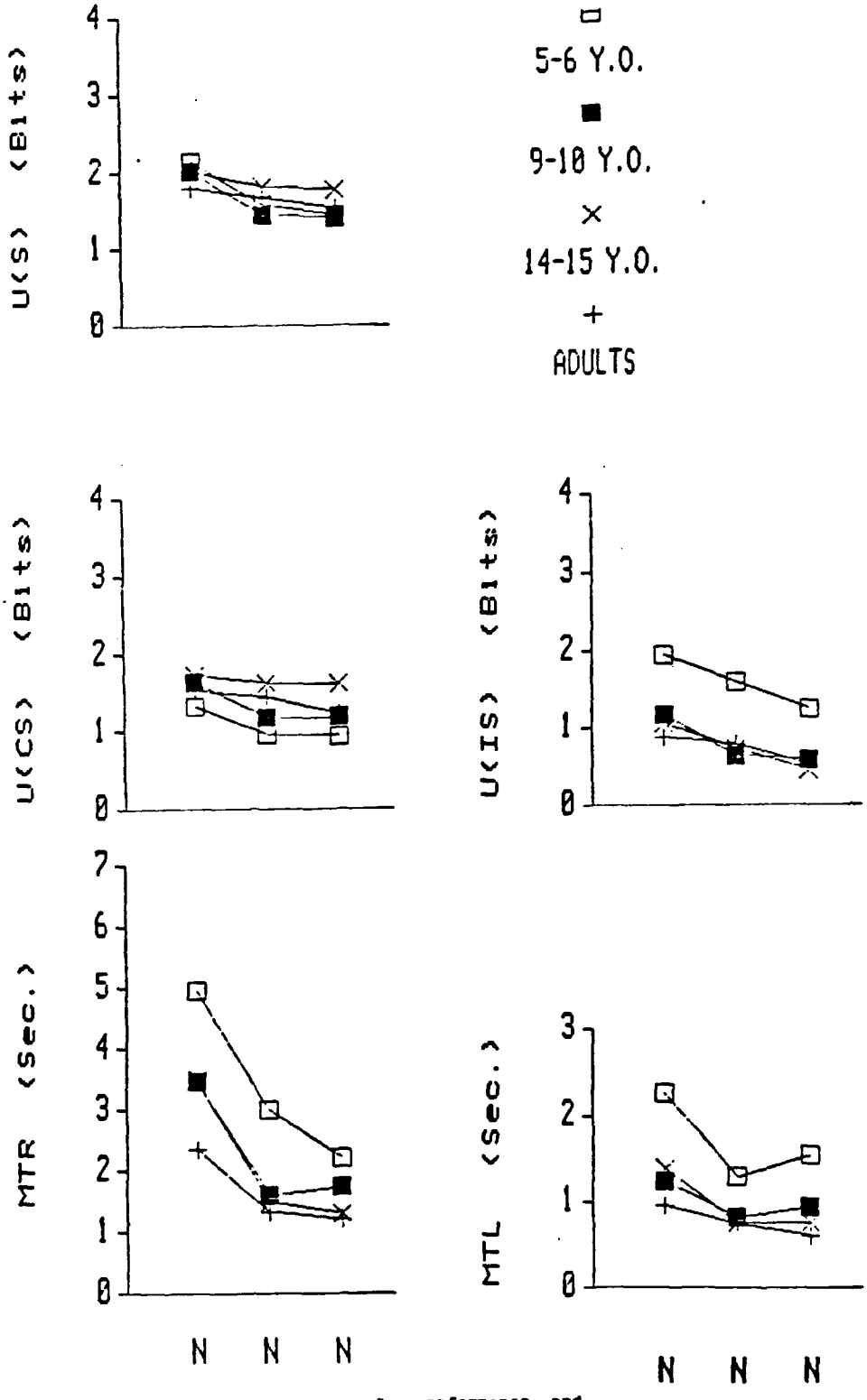

Fig. 2 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in each age-group according to sessions of the experimental group N.N.N.

3.1.1.2. Experimental group N.R.N. (see figures 3 and 4, pp.30-31).

- Performance :

The matrix R produces a significant decrease of the performance in all the age groups. The % C.S. returns to its initial level during the last session, for the first three age groups. It rises slightly for the adults.

The 5-6 y.o. constantly obtain the lowest % C.S. The Elementary School subjects seem to be the most disturbed by the incoherence of visual cues in R : they show the most important decrease of the % C.S. and then attain a level similar to the one obtained by the youngest subjects.

Realization times are also modified by R : they increase from the first to the second session, except for the 5-6 y.o. whose MTR stays at the same high level than during the first session. Afterwards, they are significantly reduced to a lower level than that reached in the first session, still except for the 5-6 y.o. whose MTR remains important. Times of latency are not so much influenced by R, except for the youngests whose MTL constantly stay at high levels.

- Variability :

For all age group, the variability of incorrect sequences (U(IS) and N(IS)) increases significantly with the matrix R. This is consistent with the decrease of the performance in R and explains, for major part, the increase of general variability (U (S)) among the 5-6 y.o., the 9-10 y.o. and the adults (significant only for the first two age groups). Despite the higher variability of incorrect sequences, global variability (U(S) and % D.S.) remains stable among the 14-15 y.o. This can be explained by the slight increase of the correct sequences stereotypy in this age group, instead of the slight decrease of this feature in the other age groups.

During the last session, the variability of incorrect sequences is significantly reduced for all the subjects, while the 5-6 y.o. maintain the

highest level.

The 9-10 y.o. and the 14-15 y.o. became more stereotyped than during the first session and reach the lowest levels for all the correct sequences variability cues.

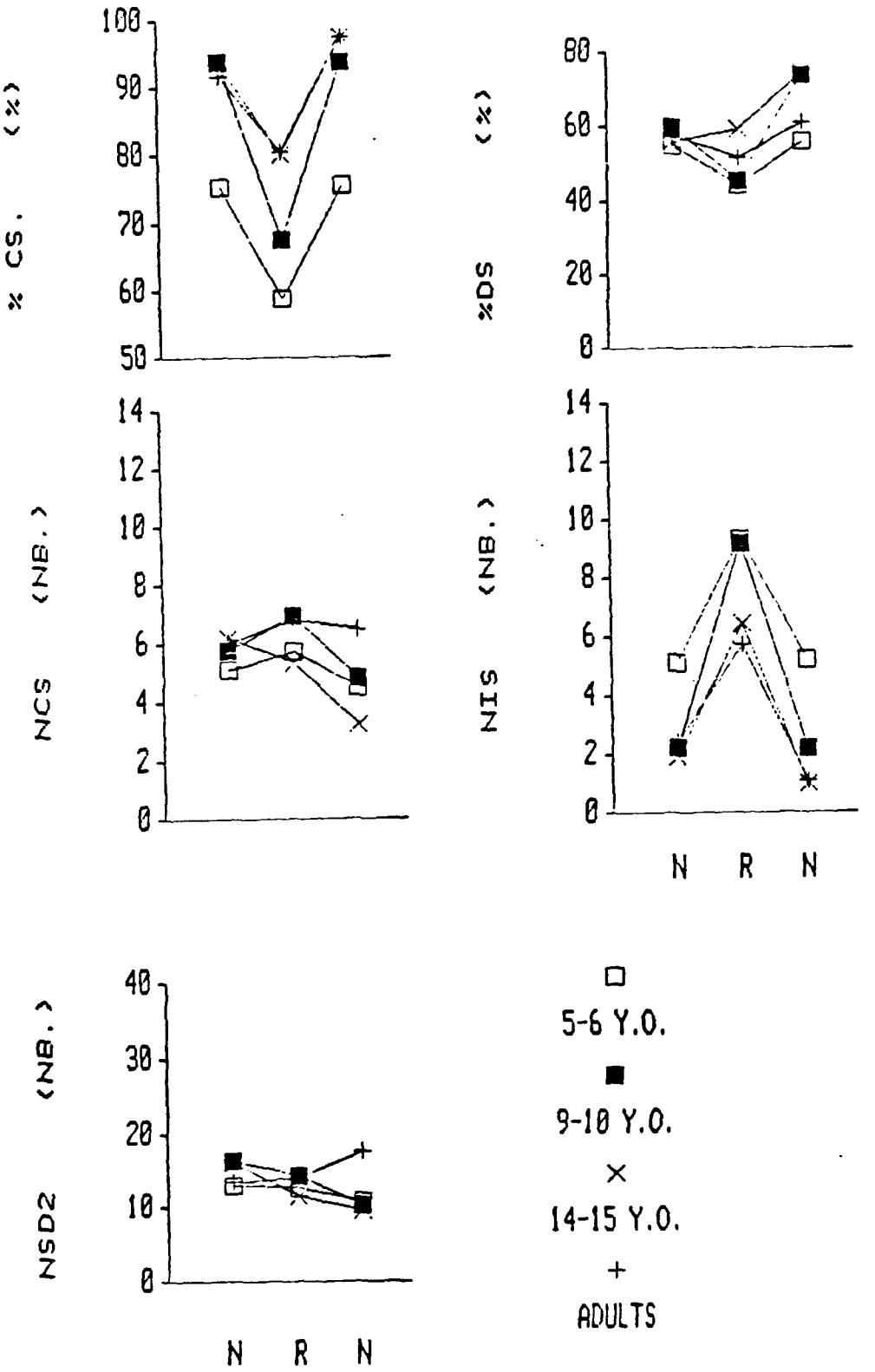

Fig. 3 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in each age-group, according to sessions of the experimental group NRN.

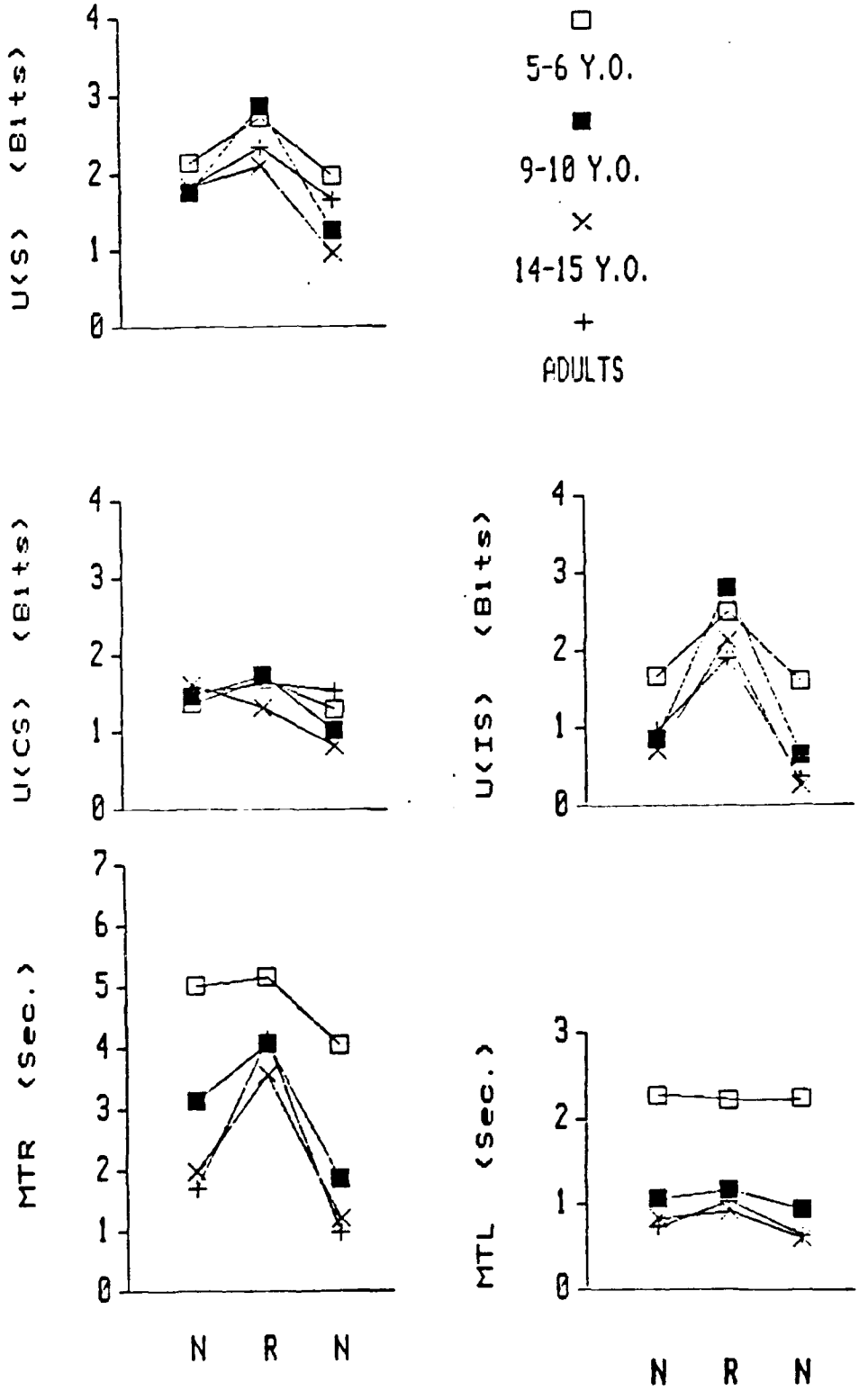

Fig. 4 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in each age-group, according to sessions of the experimental group N.R.N

3.1.1.3 Experimental group N.D.N (see figures 5 and 6 , pp.34-35).

- Performance :

The constraint of variability in D does not stop the increase of % C.S. Subjects behave like in the first experimental group NNN even if we observe, in the present case, differences between age groups during the second session. Indeed, the first two age groups do not increase their % C.S. as much as with N in second session and the two others reach a slightly higher level. But, we may suppose that the differences between age groups are due, at least in part, to slight differences in the sample of subjects.

We must take here into account a variability cue that corresponds to the mode of reinforcement in the matrix D : the number of sequences differing from the two previous ones (NSD_2). It gives, in fact, the real performance of subjects with D and it allows to assess their adaptation to the variability requirements.

During the second session, we have a significant increase of NSD_2, for all the age groups, but the percentage do not reach these obtained with the matrix N in first session (32% < 81.5% for the group 1; 50.66% < 88 % for the group 2; 77.5% < 95.62% for the group 3 and 75.46% < 91.57% for the group 4). The youngests have more difficulties to adapt themselves to the task in D. It is noted that they already differ in N from the last two age groups, on that subject. This observation can be attributed to the hazards of sampling : the youngests of this experimental group produce, at once, more correct sequences and are less variable than the youngest subjects of the first two experimental groups. In D, they are able to raise their variability, but they do not seem to understand the precise requirements of the task. We are, probably, faced with a simple respondent effect of the reduction of the number of reinforcements. It is likely to find, at least in part, the same phenomena among the 9-10 y.o., even if their performance is better (they also significantly differ from the older subjects). Adolescents and adults

have similar performances and show a good adaptation to the constraint of variability.

Except for the first age group, NSD_2 is higher in the third than in the first session, suggesting that these subjects are influenced by their earlier behaviors in D. No inter-age groups difference subsists here.

Realization times are not significantly decreased during the second session, but they are during the last session. Times of latency are longer in D than in N for the 5-6 y.o.

- Variability :

The matrix leads to a significant increase of general variability, which can be explained, for all the age groups, by the increase of the variability of correct sequences. Except for the adults (decrease of this feature), the variability of incorrect sequences stays nearly stable, but the 5-6 y.o. have a higher U(SI) than the last two age groups and, like the 9-10 y.o., produce more different incorrect sequences than the other subjects.

In each session, variability raises according to age. The 5-6 y.o. are much more stereotyped. Behaviors of adolescents and adults are comparable from this point of view.

The matrix D influences the subsequent behaviors of the last age groups. As mentioned above, their NSD_2 is higher in the third than in the first session. They also produce more different correct sequences. U(S) and U(S.C.) are higher (significant only for adults).

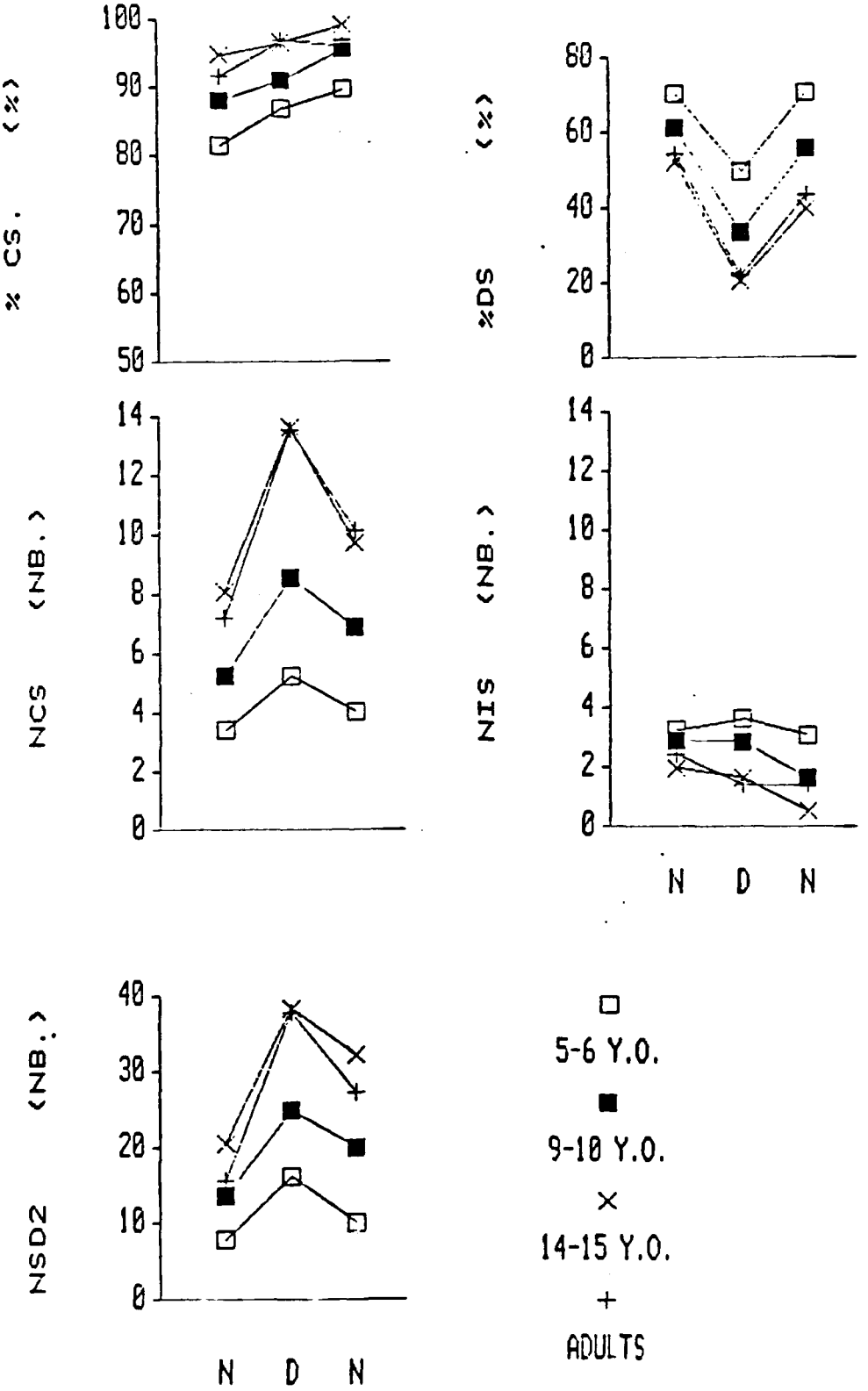

Fig. 5 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in each age-group, according to sessions of the experimental group NDN.

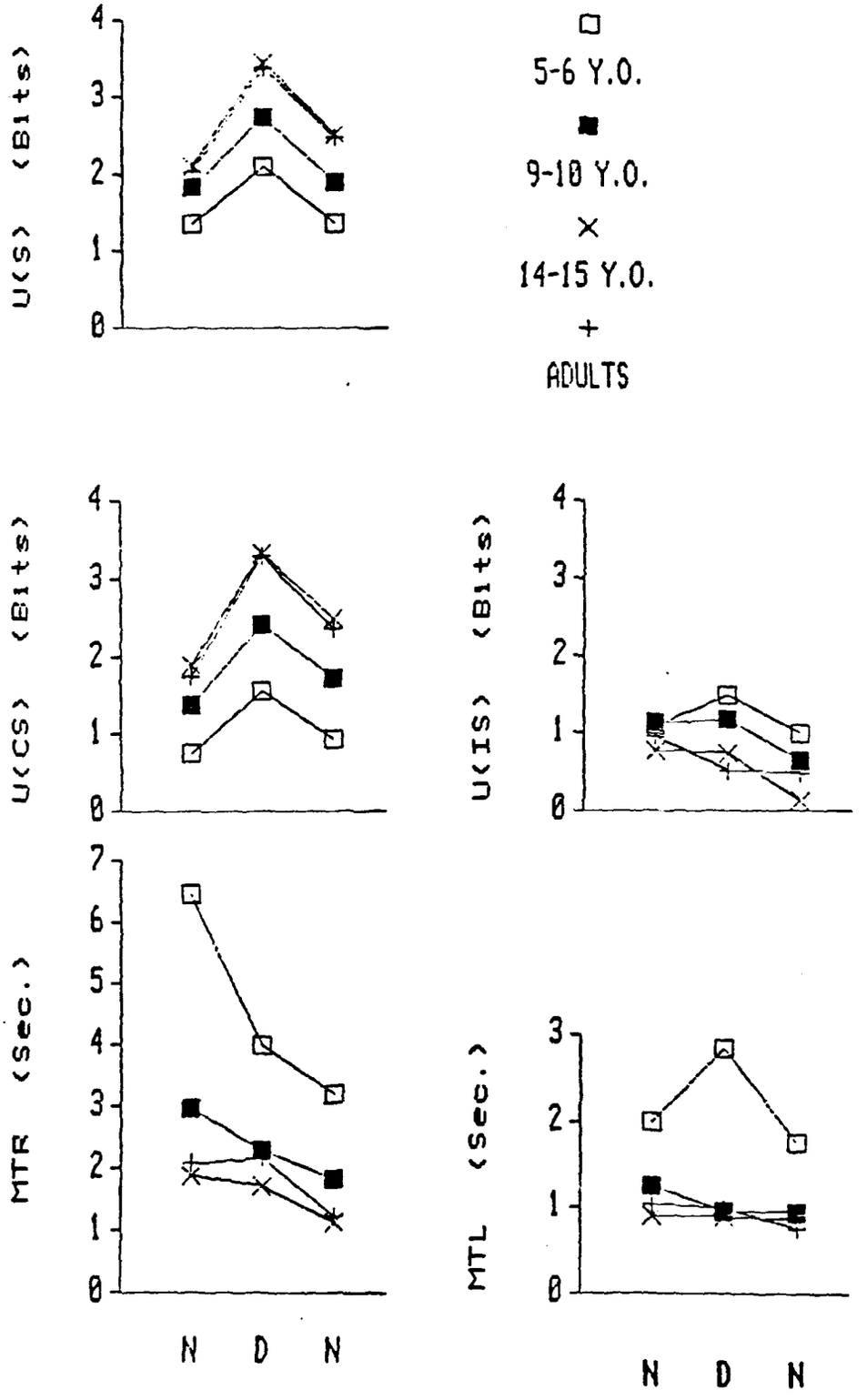

Fig. 6 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in each age-group, according to sessions of the experimental group NDN.

3.1.1.4 Experimental group D.R.N. (see figures 7 and 8, pp.39-40).

- Performance :

a) Matrix D : The % C.S. are similar, for all the age groups, to those obtained during the first session in the experimental group NNN. So, the matrix D does not influence the % C.S., as has already been noted in N.D.N.

The percentage of reinforcement (NSD_2) increases according to age, with adolescents and adults reaching comparable levels of performance. The 9-10 y.o. have a NSD_2 closer to these of the older subjects, than in D in the second session. For the youngests, the same comments as for D in NDN can probably be noted (difficulties to meet the requirements of the task and existence of a respondent effect of the number of reinforcements reduction).

b) Matrix R : Except for the 5-6 y.o., whose % C.S. stays stable, there is a decrease of this cue in R (significant only for the groups 2 and 4). The 9-10 y.o. again seem to be the most disrupted by the incoherence of visual cues (see N.R.N.). They are even worse than the 5-6 y.o. (but not significantly).

c) Matrix N : The % C.S. is significantly increased in all the age groups. These percentages are higher than those observed during the first session (significant for the groups 1, 2 and 3) and are similar to those of the third session in NNN.

In D, realization times are reduced according to age, with the last two age groups reacting in the same way. The 5-6 y.o. complete the sequences more quickly during the second session. Their MTR is comparable to that of the 9-10 y.o. The older subjects do not behave very differently from each other, but adolescents have a slight tendency to be more rapid and adults slower. In N, realization times are decreased for all the age groups. This cue stays at a quite high level for adults, in comparison with the values it reaches during the third sessions of other experimental groups

(significantly different from adolescents' MTR). Times of latency are generally higher for the first two age groups.

- Variability :

a) Matrix D : The first age group is the most stereotyped and its general variability can as well be explained by the variability of incorrect sequences as by the variability of correct sequences. Looking at the number of reinforcements (NSD_2) they receive, we may assume that their behavioral variability is less structured (adapted to the contingencies of D) than that of the older subjects.

Adolescents and adults are the most variable. The 9-10 y.o. behave in the same way, though they have a superior U (IS). The global variability of these three age groups can be explained, for the largest part, by the variability of correct sequences.

b) Matrix R : Global variability decreases in R with regards to D (augmentation of % D.S. and decrease of U (S), U(C.S.), NSD_2, NCS) among adolescents and adults. The 14-15 y.o. become the most stereotyped and adults keep a level of variability of incorrect sequences more important.

The first two age groups stay at a higher level of variability (U(S)) than the older subjects (significant only for the group 2), even if their % D.S. also increase. Their global variability reflects the variability of correct sequences and especially those of errors. That feature is particularly accentuated among the 9-10 y.o. and it goes in the same sense as their bad performance in R. The youngests adopt less different behaviors with regard to D, than the 9-10 y.o.

c) Matrix N : For the last two age groups, the better performance is parallelled with an increase inthe variability of correct sequences. It is, indeed, higher here than in R.

The 5-6 y.o. become more stereotyped (similar level to this of the third session in NNN) and the 9-10 y.o. keep a high level of global variability

(they are still the most variable, but not significantly). The U(I.S.) of these 2 groups decrease in accordance with their better performance, but stay significantly superior when the U(I.S.) of the last two age groups.

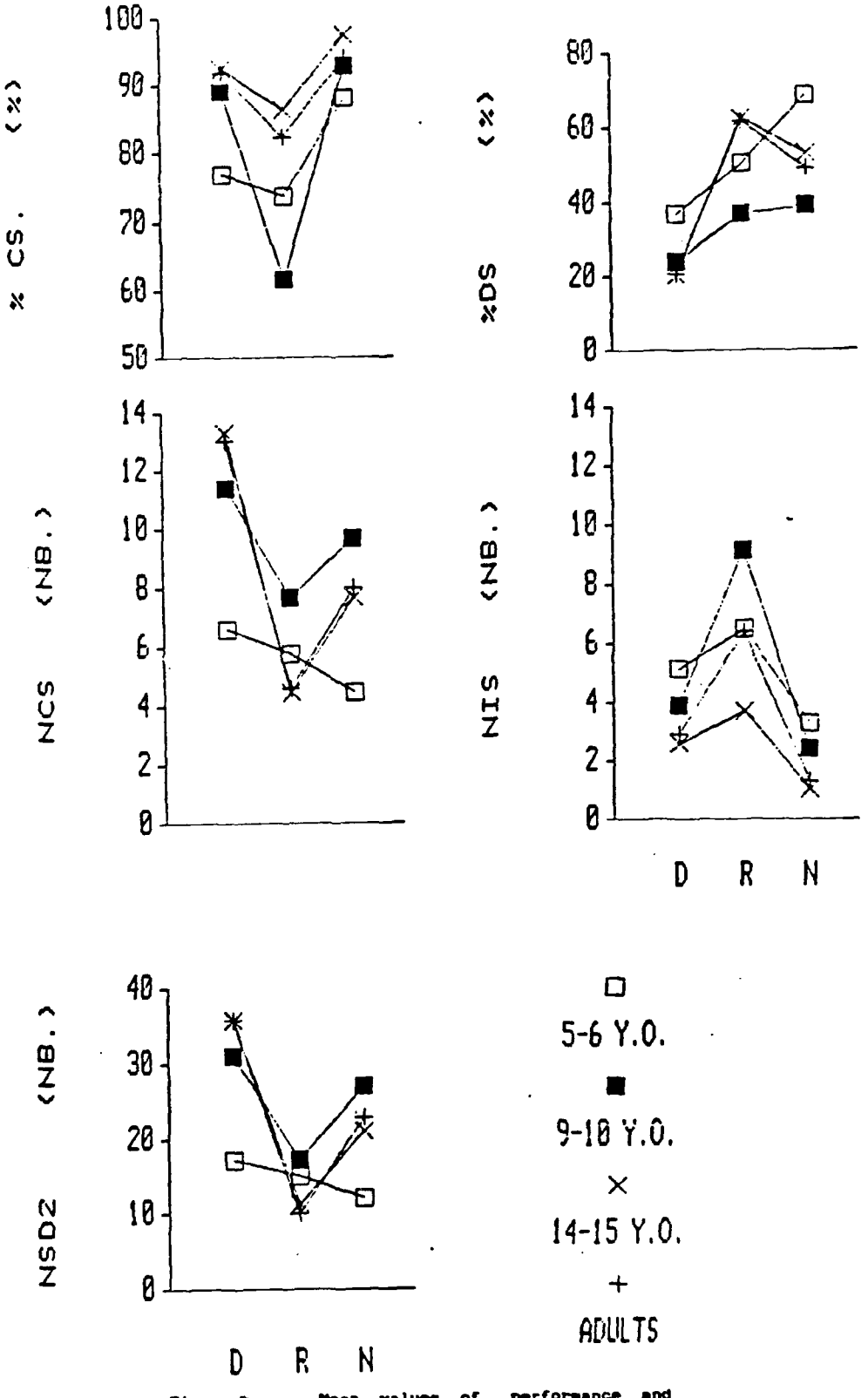

Fig. 7 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in each age-group, according to sessions of the experimental group DRN

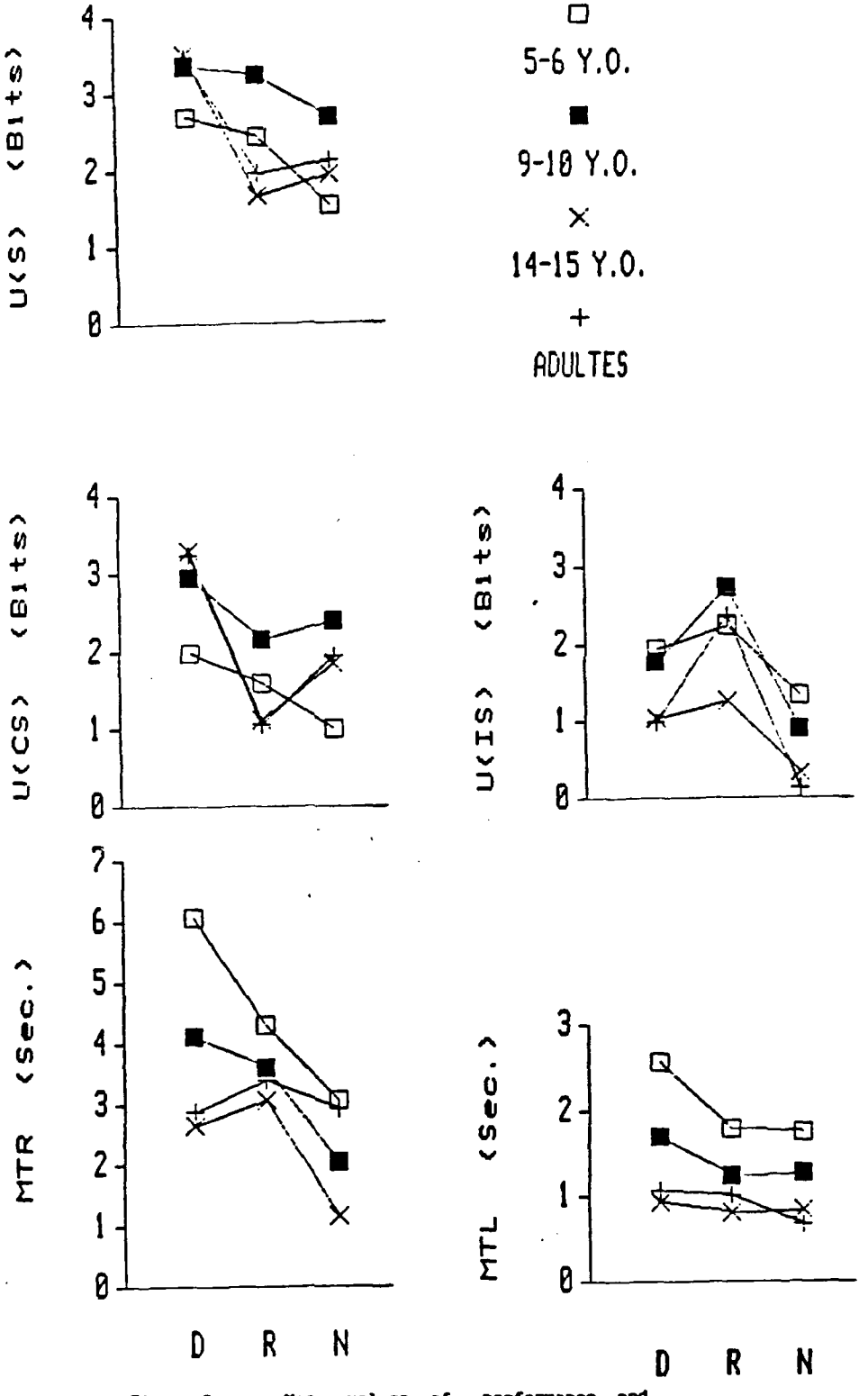

Fig. 8 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in each age-group, according to sessions of the experimental group DRN.

3.1.1.S. Experimental group R.D.N. (see figures 9 and 10 , pp. 43-44).

- Performance :

a) Matrix R : The 5-6 y.o. subjects do not seem to be influenced by the incoherence of visual cues in the first session. They behave in the same way as with N or D in the first session, and even obtained the highest % C.S. The most disrupted are again the 9-10 y.o., with the lowest % C.S. The last two age groups also reach lower levels of performance, in comparison with the other experimental groups.

b) Matrix D : The youngests keep a similar % C.S. to that of the first session. Among the other subjects, the % C.S. increase greatly (significantly superior to this of the 5-6 y.o.).

Percentages of reinforcement (NSD_2) significantly raise in D for the groups 2, 3 and 4. The adaptation to the constraint of variability shows a tendency to increase according to age. But this adaptation to the matrix D doesn't seem as good here as in the other experimental groups including D.

c) Matrix N : During the third session, the 5-6 y.o. stay at the same level of % C.S., than during the first session. The others reach higher levels of reinforcement (> 90% C.S.), like in NNN (significantly superior to this of the 5-6 y.o.).

Times of realization and of latency decrease, for all the age groups, from the first to the last session. The 5-6 y.o. are always the slowest (significant only for the sessions 2 and 3) and the 14-15 y.o. have a tendency to be the fastest. Adults get the same levels as those obtained by the last subjects in the third session.

- Variability :

a) Matrix R : For all the subjects, the variability of incorrect sequences is higher than the variability of correct sequences.

The Primary School subjects are significantly the most variable,

with regard to correct and incorrect sequences. The 5-6 y.o. and adults are the most stereotyped. Parallel to their good performance (the best of all the age groups), the youngests show the lowest variability of errors (significant for U(IS) and NIS).

b) Matrix D : The variability of the 5-6 y.o. stays nearly stable, as well for correct sequences as for incorrect sequences. They produce more often their dominant sequences and are significantly more stereotyped than the other subjects, with regard to their correct sequences. The 9-10 y.o. do not change their variability of correct sequences, but strongly reduce that of incorrect sequences. This last point can explain why they become globally less variable than in R. The sequences uncertainties of the last two age groups increase (significantly for adults). It's the raise of the correct sequences variability that accounts for it, since the incorrect sequences variability significantly decreases among these two group.

c) Matrix N : In each age group, global variability and, particularly, the variability of incorrect sequences are lower during the third session. The uncertainty of correct sequences is lower in N than in D, for all the subjects, and is a bit lower than in R, for the first two age groups. It's higher than in R for adolescents and adults.

The 5-6 y.o. are the most stereotyped with regard to their correct sequences and the most variable with regard to their errors (significant for the following cues : U(I.S.), N.I.S., U(C.S.)).

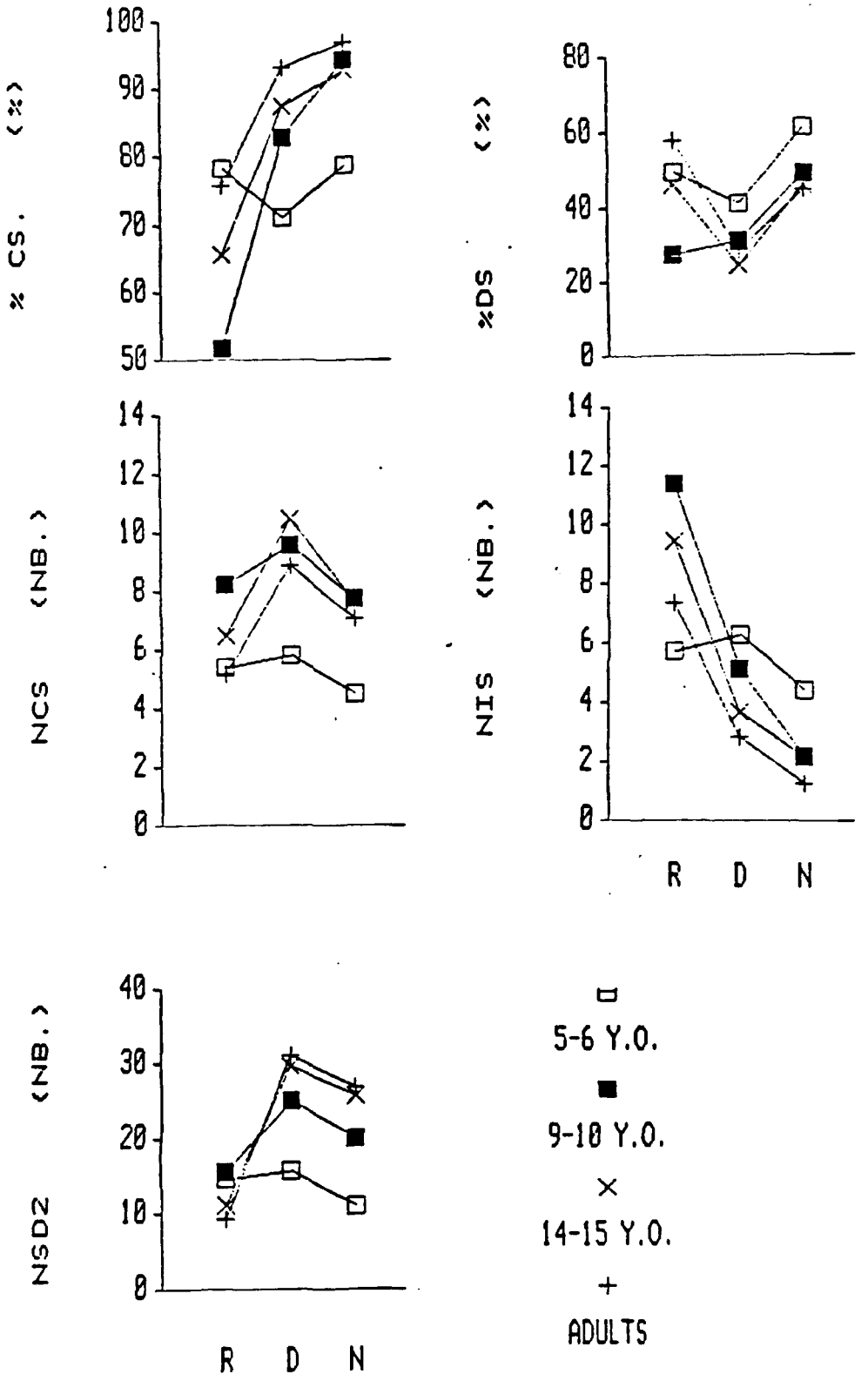

Fig. 9 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in each age-group, according to sessions of the experimental group RDN.

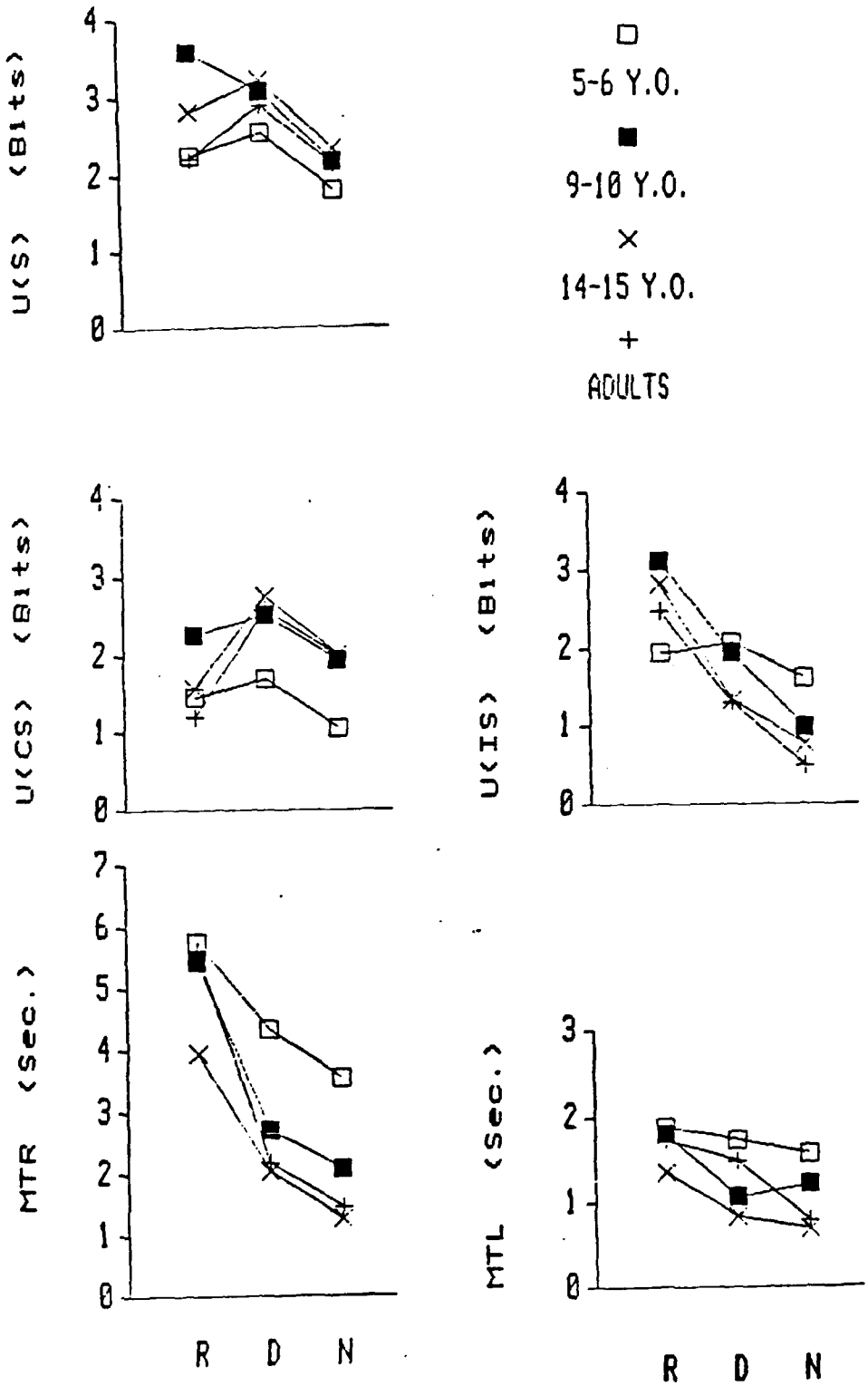

Fig. 10 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in each age-group, according to sessions of the experimental group RDN.

3.1.2. Inter-experimental group comparisons.

Principles of analysis.

1. Comparison of behaviors, according to matrix type and to age.

A. Naïve subjects : We compare the results obtained with the matrixes N, R and D in first session, to study spontaneous behaviors presented by naïve subjects faced with these matrixes.

In each age group, we have assembled the results of subjects who have received N in the first session (subjects from experimental groups NNN, NRN and NDN), in order to compare the set of their results with those of subjects who have received R or D in first session (subjects from experimental groups RDN and DRN). The general profile of results with N in first session is called "global N" (GN).

We also compare the matrixes R and D, in the first session.

After having assessed, for each cue, the effects of the factor "age" and of the factor "matrix" (Anova (F)), we compare :

- the three matrix types inside each age group
- the four age groups faced with each matrix type

(Anova (F) and Newman-Keuls procedure (NK)).*

B. Pre-trained subjects with the matrix N in first session : We use the same principles of analysis, to compare the results obtained with the matrixes N, R and D, by pre-trained subjects in N. So, we take here into account the second sessions of experimental groups NNN, NRN and NDN.

* When application conditions of these tests are not satisfied when variances are not homogeneous and when sizes of compared groups are too different; (for example, when naïve subjects with N in the first session (GN) are compared with other subjects), we use non-parametric tests : (χ^2) and Man-Whitney (U).

2. Effects of different pre-trainings.

A. We compare the results obtained with the matrix R in the second session, according to pre-training in N or in D (subjects from experimental groups NRN and DRN) and according to age.

B. We compare the results obtained with the matrix D in the second session, according to pre-training in N or in R (subjects from experimental groups NDN and RDN) and according to age

For A and for B, we use Student-T test (t).

C. We compare the results obtained with the matrix N in the third session, according to five possible pre-trainings (NN, NR, ND, DR and RD) and according to age.

We use the same statistical tests than in 1.A.

(for the means of each cues according to age and to presentation order of matrix type, see table 12 to table 21, in annex pp27-31)

3. Dominant Sequences.

This cue has been selected for its possibilities to bring more qualitative informations about the organization of subjects' behaviors.

We give the results concerning the dominant sequences (DS) inside the different types of analysis described here above,for the first session.

We have distributed all the dominant sequences into four groups, according to our anterior observations (more frequent DS types) :*

1. Corner sequences (AAABBB or BBBAAA).
2. Diagonal sequences (ABABAB or BABABA).
3. Other correct sequences (AABBBA, BABBAA, ..., for example).
4. Erroneous sequences (AAAA, BBAABB, ..., for example).

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*A = one push on the right response- button

B = one push on the left response- button.

We analyze the DS distribution according to matrix type in one age group and according to age for one matrix type. We give the contingency tables, including the frequencies and the percentages for each DS type.

We did not make this analysis for the second and the third session, because of its exploratory nature. Our purpose was, in fact, to determine the matrix type effects, according to age, on the DS choice. To analyse the evolution of the DS distributions in the other sessions, would have imply to consider individual DS changes and would have need too ccomplex analyses.

3.1.2.1. Comparison of behaviors according to matrix type and to age.

3.1.2.1.1. Naive subjects (NNN, RDN, DRN) (see figures 11, 12, 13 , pp. 53, 54, 55).

- Adult subjects :

The results of adults show that they are sensitive to environmental factors and to particular contingencies of reinforcement :

- Their percentage of correct sequences is lower in R than in N or in D and, in the same way, the variability of incorrect sequences (U(IS) and NSI) is higher with R than with the two other matrixes.

This suggests that adults' behaviors are disturbed by the incoherence (random displacement) of light cues.

- These subjects are able to adopt more variable behaviors, when contingencies of reinforcement require it : the global variability (with regards to %DS andU(S)) is greater with D, and it can be explained by the variability of correct sequences (U(CS) and NCS), that is significantly higher in D than in N or in R.

They show a good comprehension of the constraint of variability (NSD_2 is the highest in D).

- It's the task in N that takes the lowest time (as well for MTR as for MTL). MTL are similar for R and D, but MTR is higher with R.

- The DS are significantly differently distributed according to matrix types. That difference may especially be attributed to R effects : with this matrix the greatest part of subjects (73.7%) prefer diagonal sequences as DS, while in N and in D, the subjects prefer corner sequences (respectively, 7.,1% and 60%).

Two hypotheses can be suggested the subjects have not any visual landmark in R and the easiest way to solve the problem is to adopt a "motive" strategy, it's to say, just to alternate their pushes on the two response-buttons. On the other hand, the results may also suggest that with

N and with D, adults prefer to use the visual information, following the lamp course on the matrix.

The subjects show a slight tendency, in D, to choose more often other sequences than corners or diagonals as DS, than in DN This is probably one effect of the variability constraint, but that phenomenon is not very pronounced in the adults' case.

- 14-15 y.o. subjects :

- In general, adolescents behave in a similar way to adults. The number and the variability of incorrect sequences are greater in R and the variability of correct sequences is higher in D.

- Even if the ANOVA according to age factor for each matrix type) does not reveal any significant difference between adults and adolescents, the latter tend to be more disturbed by the incoherence of light cues and to perform better in N and in D, than adults. On the other hand, they also show a tendency to be more variable with each matrix type.

- MTR is higher with R than in the other cases.

- As for adults, the DS differ according to matrix type.

In N and in R, we observe the same distributions than for these last subjects, but we note a difference between the two age groups in D : adolescents prefer to make other sequences than corners or diagonals. This remark seems to support the hypothesis we have already suggested, following which adolescents would tend, in D, to adopt more various behaviors than the subjects of other age groups.

-9-10 y.o. subjects :

- Like for the older subjects, the number and the variability of incorrect sequences are higher in R and the variability of correct sequences is greater in D.

But the variability of incorrect sequences is here more important in

D than in N and the variability of correct sequences is more important in R than in N. The differences between matrixes R and D are not so great for these subjects, as compared to the two groups already described. Both, the higher variability of correct sequences in R and the less good adaptation to variability contingency in D, explain why there is no difference between R and D with regard to the global variability.

-The 9-10 y.o. subjects are much more disturbed by the random displacement of light cues, than are the other age groups : their performance is significantly inferior and they are more variable (even for correct sequences) in R.

They have conversely a tendency to be more stereotyped in N and in D, with regard to correct sequences than the older subjects (however, differences between age groups aren't significant for this last point).

- MTR and MTL are the lowest in N.

In D, these subjects are significantly slower than the older ones and they also complete the sequences slower than those in N. No difference between age groups in R, has been noted as this matrix takes more time to be solved, for all the subjects.

- Their DS in N are similar to those of adults and adolescents.

In D, they behave in an intermediate way to these two age group (they have nearly as much corner DS as various DS). In R, their behaviors are not very different from those of the other age groups (more diagonal DS) but, parallel to their bad performance in R, they show a tendency to choose more often erroneous DS (χ^2 between age groups is not significant) and they have a percentage of diagonal DS lower than these of the other subjects.

-5-6 y.o. subjects :

- Contrary to the other age groups, the 5-6 y.o. are not very disturbed by the incoherence of visual cues in R. Their % CS is similar to the one they obtain with N. They even perform better than all the other groups of

subjects (not-significant between them and the last two age groups)
They are or they tend (it depends on which cue is being condidered), with adults, to be the most stereotyped. Tet lower behavioral variability in R can account for their better performance.
It would be the opposite phenomenon to which we observe among the 9-10 y.o., who are theworst performers and the most variable in R.

- On the other land, they have the greatest difficulties to adopt more variable behaviors when the reinforcement contingency requires it (their % CS and NSD^2 are significantly lower than those of other subjects).
They show themselves more variable with D than with N, with regard to the global variability and to the variability of correct sequences, but it is not true for every cue (NCS is not different from those of other matrixes). However, all these cues are less important for this age group in N and in D, than for the other subjects. They are thus the most stereotyped, from this point of view, with these matrixes, but they are still the most variable with regard to incorrect sequences.

- Except the greater variability with D in comparison with N, these subjects adopt quite constant behaviors, independently of particular conditions to which they are submitted.

- MTR and MTL are similar for the three matrixes.
The 5-6 y.o. subjects are always slower than the other ones.

- Except in R, where DS are above all diagonal sequences for all the subjects, the 5-6 y.o. differentiate themselves from the other subjects. They always emit more diagonal DS. This observation concords with the remark we pointed out earlier about the constance of their behaviors in all situations.
They adopt the most frequently the "motive" strategy, that leads to reinforcement in N and in R, without the necessity to link their pushes to displacement of light cues. They react, in fact, like the other age group in R, when the visual feedback cannot be used to solve the task. That allows them

to pass through difficulties, even if they do not really understand what is going on. In that sense, they show a good behavioral adaptation for their young age but, in some case, like in D, it does not help them to obtain reinforcements, because their behavior offers them few possibilities.

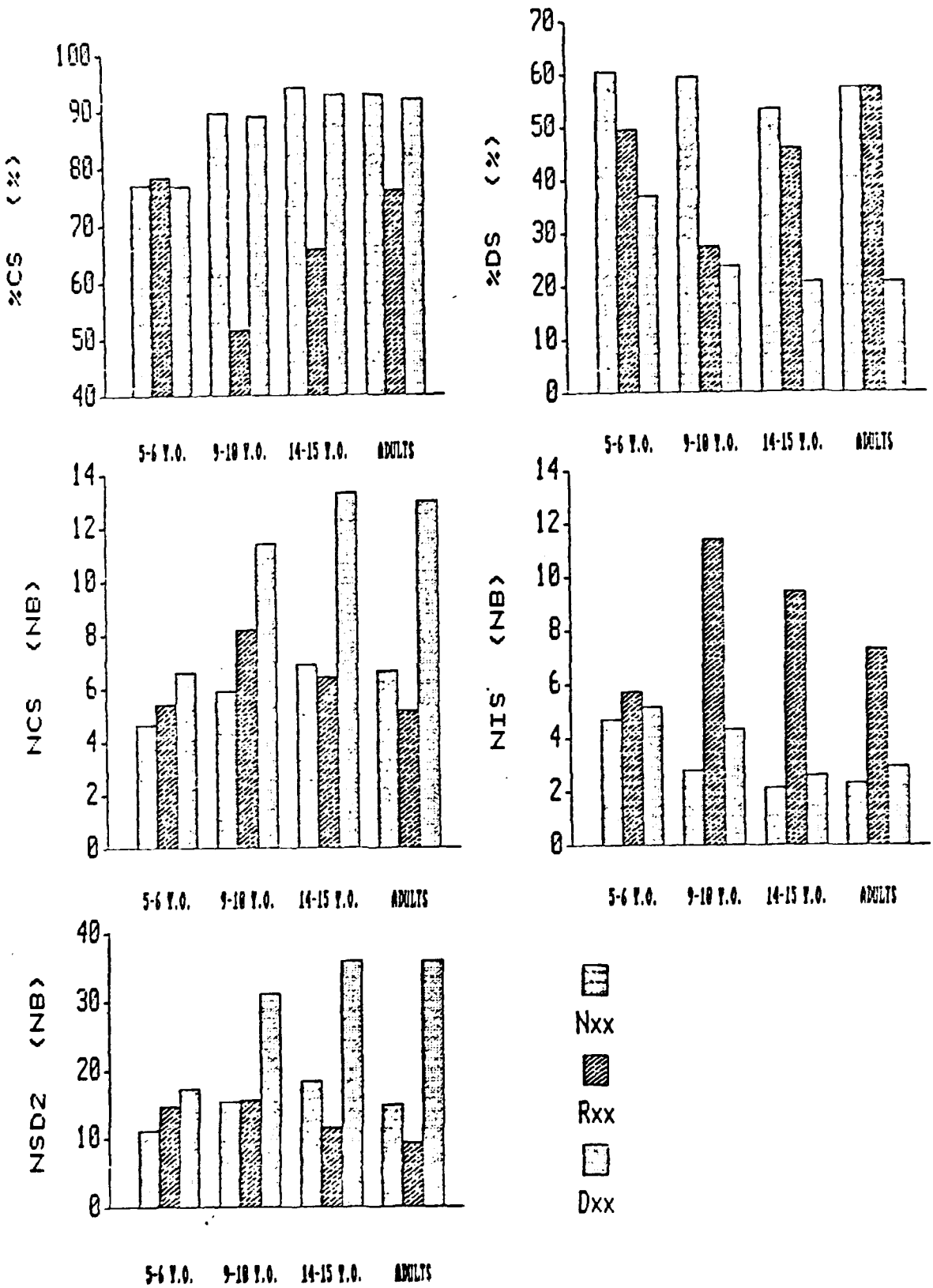

Fig. 11 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) according to age and to matrix types, in the first session.

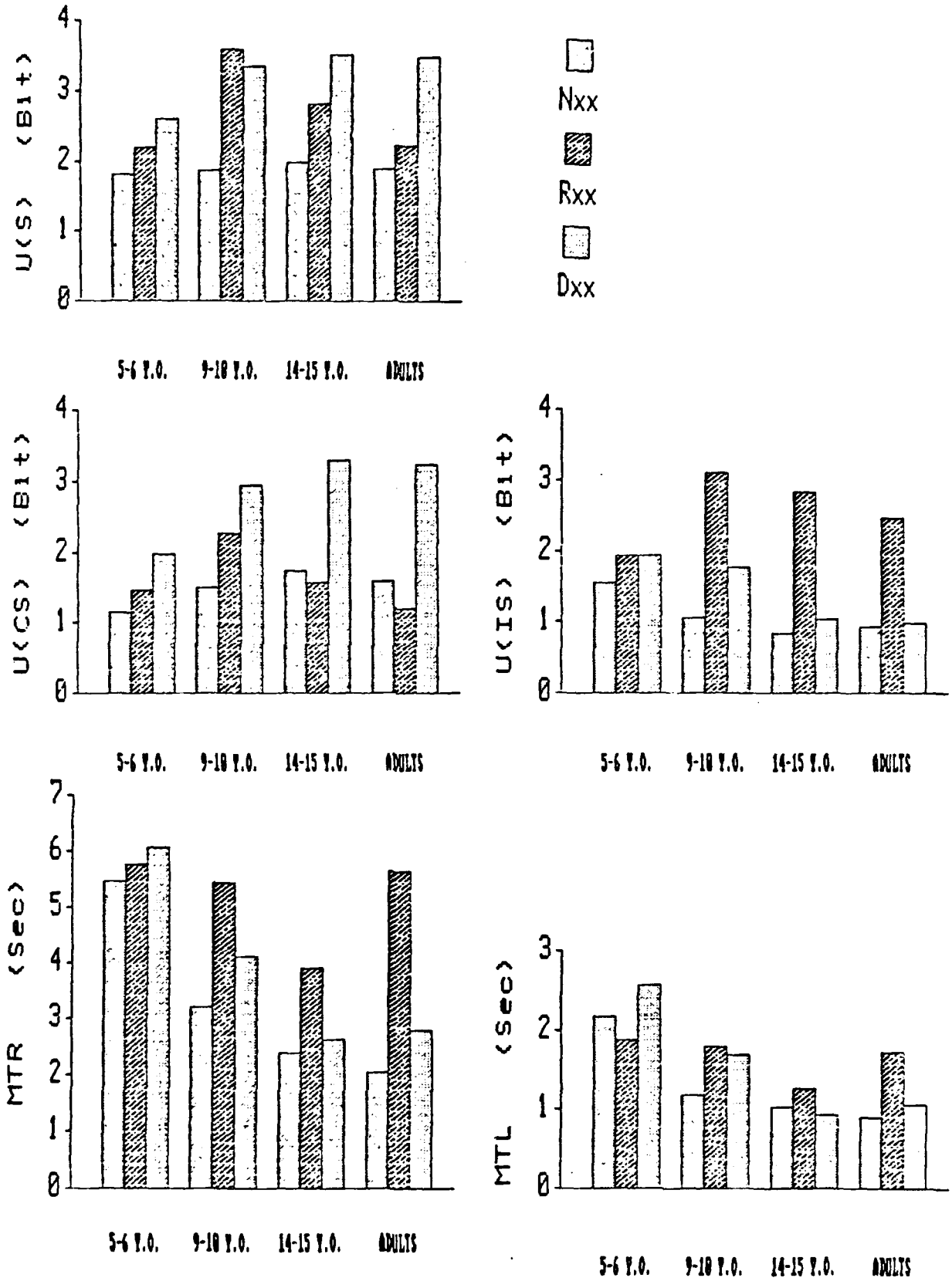

Fig. 12 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) according to age and to matrix types, in the first session.

DOMINANT SEQUENCE TYPES

GN

AGE / DS	5-6 Y.O. N=49	9-10 Y.O. N=57	14-15 Y.O. N=56	ADULTS N=61
1 CORNER	20 40.80	49 86.00	44 78.60	44 72.10
2 DIAGONAL	21 42.90	4 7	4 7.10	9 14.80
3 OTHER	4 8.20	3 5.30	8 14.30	8 13.10
4 INCORRECT	4 8.20	1 1.80		

R

AGE / DS	5-6 Y.O. N=17	9-10 Y.O. N=17	14-15 Y.O. N=21	ADULTS N=19
1 CORNER			1 4.80	1 5.30
2 DIAGONAL	17 100	11 64.70	16 76.20	14 73.70
3 OTHER		2 11.80	2 9.50	2 10.50
4 INCORRECT		4 23.50	2 9.50	2 10.50

D

AGE / DS	5-6 Y.O. N=13	9-10 Y.O. N=17	14-15 Y.O. N=21	ADULTS N=20
1 CORNER	1 7.70	8 47.10	6 28.60	12 60.00
2 DIAGONAL	10 76.90	2 11.80	2 9.50	3 15
3 OTHER	1 7.70	7 41.20	13 61.90	4 20
4 INCORRECT	1 7.70			1 5

Fig. 13 : Frequencies and percentages of DS types according to matrix type, in the first session, and to age

3.1.2.1.2. Pre-trained subjects with N in first session (NNN, NRN, NDN). (see figures14 and 15 , pp.58-59).

- Adult subjects :

- Globally, the pre-trained subjects with N do not show any modification in the differences which were observed in the matrixes N, R and D among naïve subjects. It is noted that MTL are similar for the three matrixes and that there is no difference between MTR in N and in D (naïve subjects'MTR was higher in D than in N).

- However, when we compare the cue values in the second session, with the cue values obtained by naïve subjects, it is remarked that stereotypy tends to be higher with N in the second session. Adults tend to do less incorrect sequences in R after N. There is no difference between D after N and D in first session. We can thus deduce from these results that, for adults, a pre-training with N facilitates the performance in R, but does not modify the subjects'capacity to be more variable when contingencies require it. This pre-training in N probably plays the role of an habituation to the task.

- 14-15 y.o. subjects :

- Differences between matrixes N, R and D in the second session are similar to those observed in the first session. The pre-training in N seems to have the same effects as those described among adults : it slightly increases the stereotypy in N and facilitates the performance in R. However, it does not modify the subjects'variability in D.

- Like the naïve subjects of this age group, adolescents tend to be generally more variable than the adults and not as good as the latter in the matrix R.

- 9-10 y.o subjects :

- The number and the variability of incorrect sequences are, also,

significantly higher in R than in N and in D, NSD_2 and U (CS) are significantly greater in D than in N and in R.

- Differences between naïve and pre-trained subjects are more pronounced than among the older subjects.

When we compare the cue values in both situations, it is found that the performance and the stereotypy are superior with N and with R in the second session. The % CS and the stereopypy are also higher with D in the second session. The pre-training in N has thus a facilitation effect on the performance in R. However, in contrast to the two groups described above, the habituation to the task interferes with the capacity to adapt oneself to the variability constraint in D.

- These pre-training effects influence the way by which the 9-10 y.o. differentiate themselves from the other age groups subjects. While in the first session, the 9-10 y.o. performance was significantly inferior and they were more variable with R as compared to the other subjects, they do not behave differently from others with R in the second session. The reverse phenomenon with the matrix D can be noted.

- Only MTR stays significantly higher in R than in N and in D.

- 5-6 y.o. subjects :

- The pre-trained subjects performance in N is significantly inferior and they are more variable in R than in N, while there is no difference between the results with N and with R among naïve subjects.

This observation cannot only be explained by the increase of the performance and of the stereotypy in N in the second session because, in R, the pre-trained subjects performance is also inferior and they are more variable then the naïve ones. So, contrary to all the other age groups, the pre-training session with N shows a disturbing effect on the 5-6 y.o. beheviors in R. They become significantly less able performers then the other subjects while being the best performers and the most stereotyped

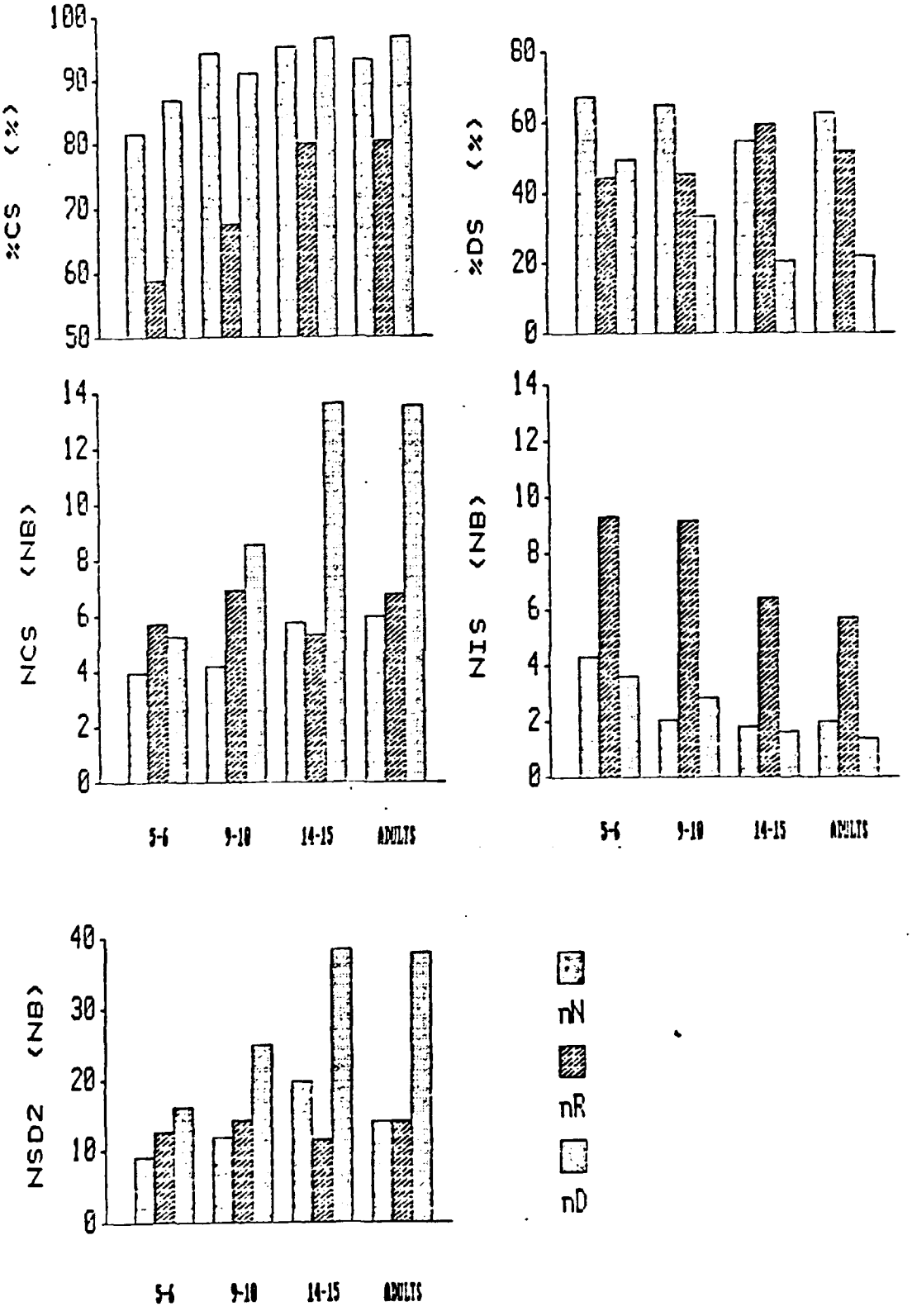

Fig. 14 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) according to age and to matrix types, in the second session.

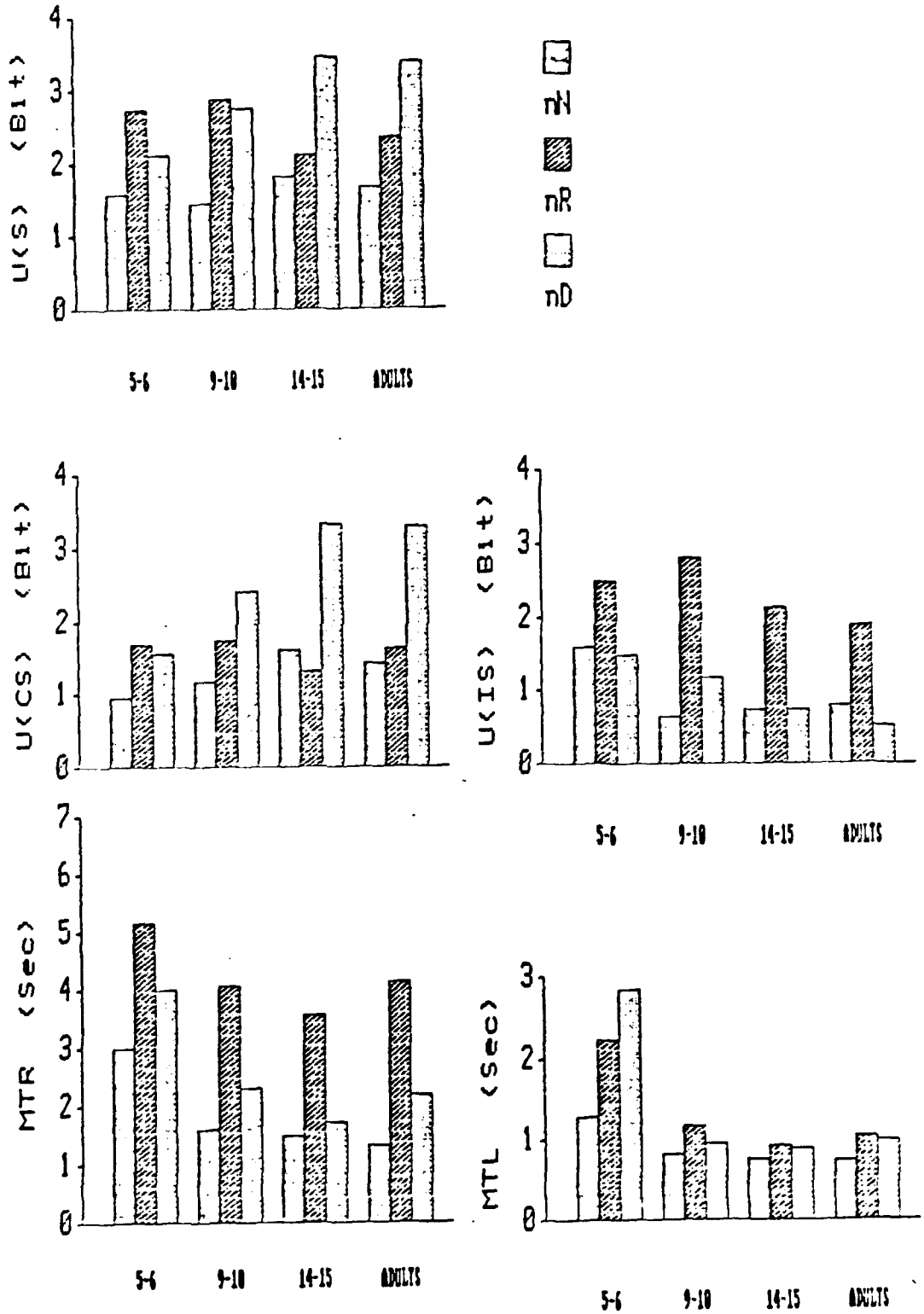

Fig. 15 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) according to age and to matrix types, in the second session

with R in the first session.

- Like for the 9-10 y.o., the pre-training with N reduces the 5-6 y.o. variability in D and they are again less variable than the other subjects.

- According to their reactions after N, when they are submitted to another experimental situation (R or D) including the same task, it could be suggested that the 5-6 y.o; have difficulties to change their behaviors for more adapted ones, once they have already developed some strategy to solve the task.

3.1.2.1.3. Effects of different pre-trainings.

- Effects of pre-trainings with N and with D on behaviors in R in second session (NRN, DRN).
  Effects of pre-trainings with N and with R on behaviors in D in second session (NDN, RDN). (see figures16 and 17 ,pp.61-62).

No matter which age group is analysed, no significant difference is found between the cues values of R or D, in second session, according to subjects' pre-training (respectively, with N or D and with N or R).

However, if we consider the behaviors in R, the following tendencies are noted :

- For adults and adolescents, the pre-training with the matrix D seems to have a stronger facilitation effect, than with N, on the performance in R. It also leads to a higher stereotypy in R. Such an effect appears more likely to be a related effect to the good performance in R (as we have seen it in the other analysis including R). It seems unlikely that such an effect can be attributed to the matrix D itself. So, the pre-training in D would help the subjects to find more easily a satisfying solution in R.

- For the 9-10 y.o., the facilitation effect of the pre-training in D is less marked than that of the pre-training in N. Like the naïve subjects of

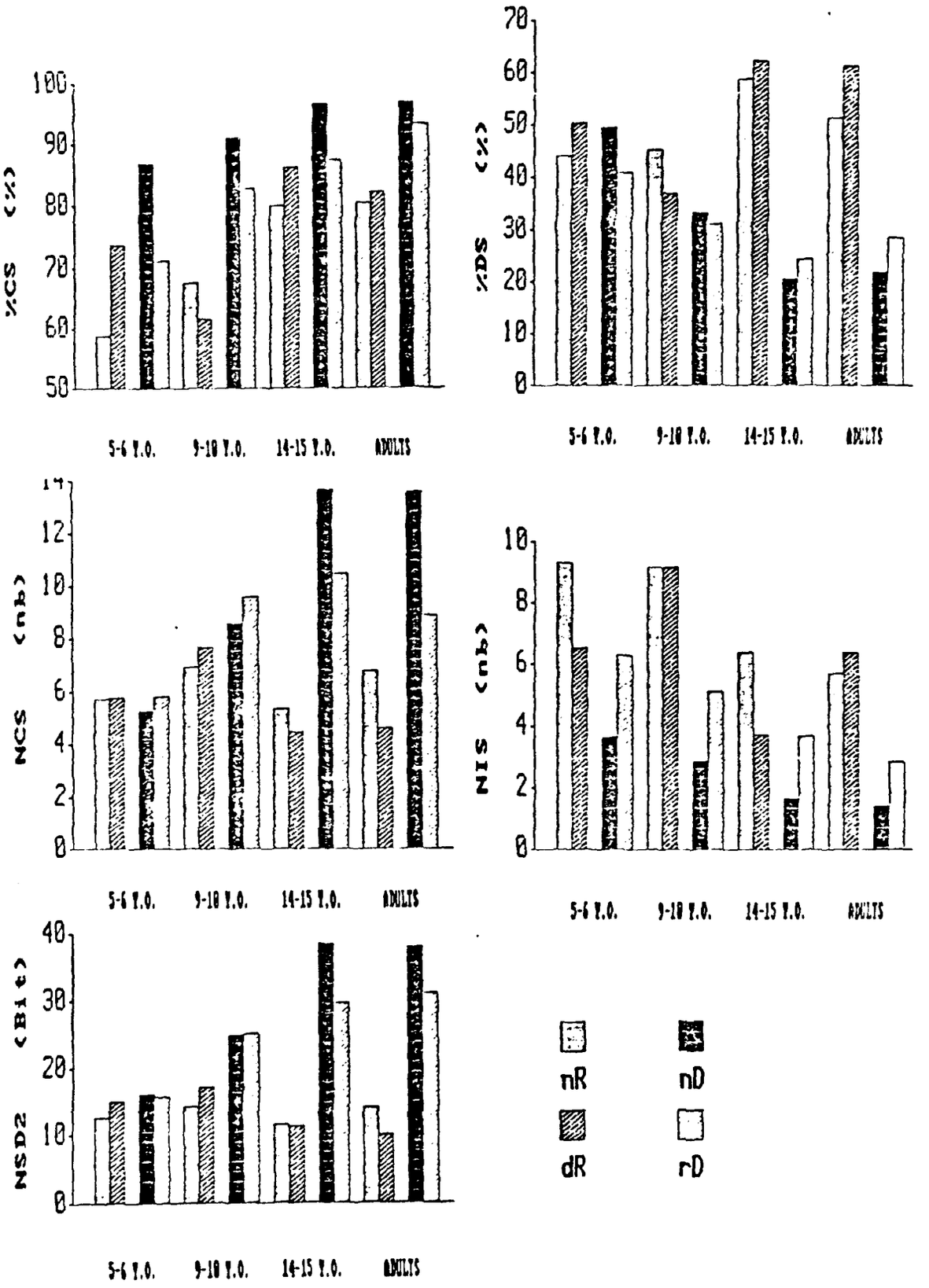

Fig. 16 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in R and D (second session) according to age and the 1 pretraining type.

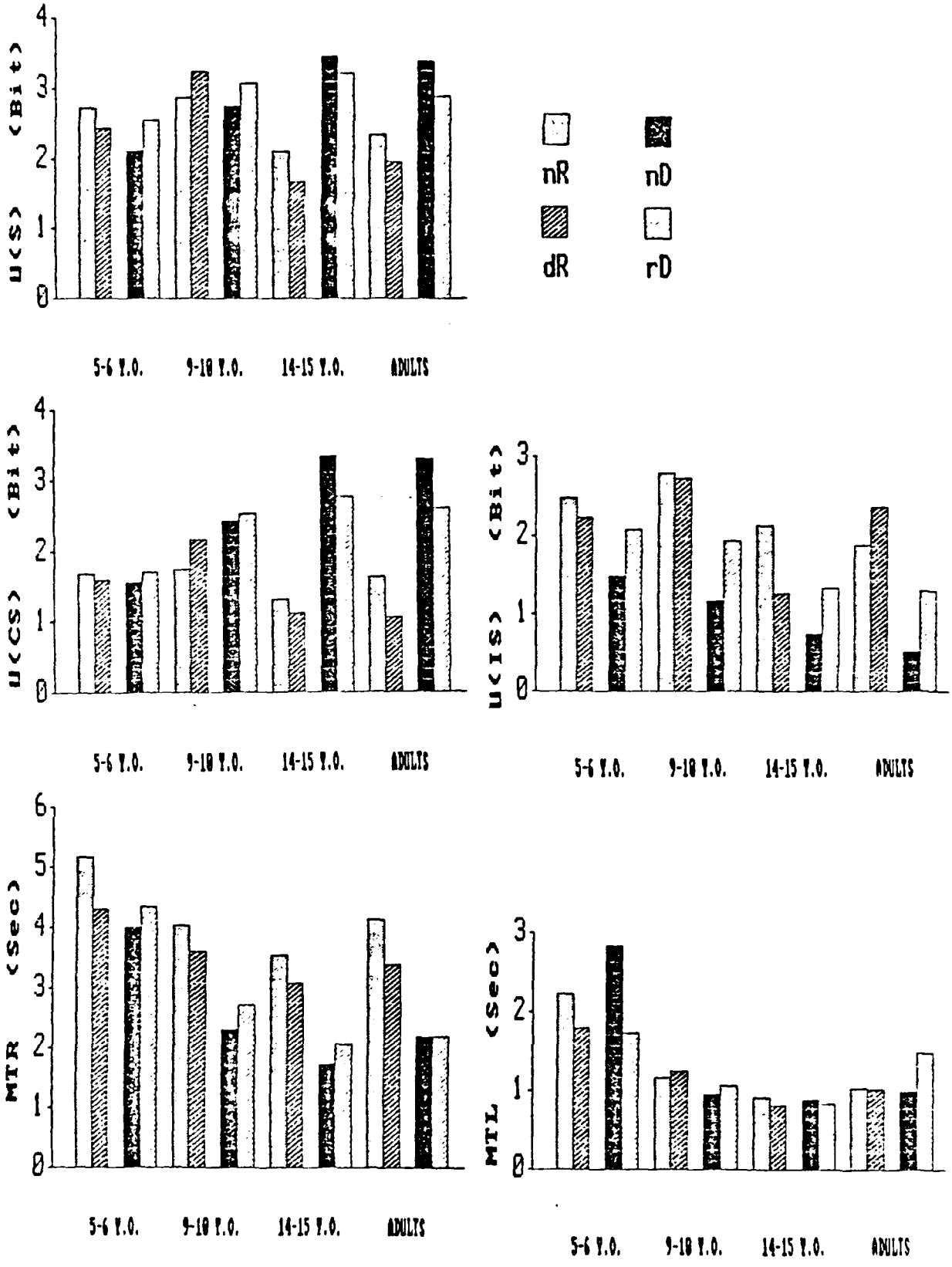

Fig. 17 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in R and D (second session) according to age and to pre-training type.

this age group, the 9-10 y.o. , pre-trained with D, are significantly less able performers and the most variable in R, while there is no difference between th 9-10 y.o., pre-trained with N, and the other subjects.
It seems that the request of variability during the first session, does not help the 9-10 y.o. to find a good solution in R.

- For the 5-6 y.o., the disturbing effect of the pre-training in D is less important than that obtained with the pre-training in N. Subjects with D in the first session behave in a similar manner to the naïve subjects in R. This is probably due to the fact that when matrixes are more different from each other (it's the case between D and R), the youngest subjects'behaviors are less influenced by their anterior behaviors.

If we consider the behaviors in D, the following tendencies are observed :

- Compered with pre-training in N, the pre-training in R leeds to a slightly lower variability in D, for adults and adolescents (but the differences betweeen naïve and pre-trained subjects are very small).

- For the 9-10 y.o., the number and the variability of incorrect sequences in D are higher after the pre-training with R than after N, but the two types of pre-training effects are not different with regard to the variability of correct sequence (U(CS) and to the performance (NSD_2) in D.

- We see the same phenomenon among the 5-6 y.o.

For these last two age groups, the higher number of incorrect sequences after R as compared to after N, probably reflects their additional trials and errors to understand the new relations between their pushes and the displacemenst of the bag.

- Effects of five different pre-trainings on the behaviors in N (NNN, NRN, NDN, DRN, RDN). (see figures18 and 19 ,pp.65-66).

- As regards the % CS, the incorrect sequences variability and the MTL, the Two-Way ANOVA does not reveal any effect of pre-training. Only

the age effect is significant for all the experimental groups, the 5-6 y.o. are the slowest (as concerns both MTR and MTL) and less able performers. The One-Way ANOVA is significant for experimental groups NRN, NDN and RDN). Adults and adolescents are the fastest.

- The 14-15 y.o. have a higher incorrect sequence variability after the pre-training with RD. Except this case, the first hundred trials mainly influence the correct sequence variability.

- Adults, adolescents and 9-10 y.o., who have been submitted to the matrix D during the pre-training, show more variable behaviors in N in the last session. At least two hypotheses can be suggested : firstly, some subjects having understood that several correct sequences can be used, may vary during the last session to interrupt the task monotony (but if it was the case, subjects would probably have adopted; the same behaviors in the third session of NNN); secondly, it is quite possible that some subjects do not remark the contingencies modification when the matrix N follows the matrix D. The pre-training which leads to the most variable behaviors in N is ND, followed by RD, for adults and adolescents. For the 9-10 y.o., it is DR followed by RD. The pre-trainings which lead to the most stereotyped behaviors during the last session are NN and NR.

- For the 5-6 y.o., the behaviors in N are not modified by a particular type of pre-training. They are the most stereotyped in all the experimental group. Except the last session of experimental group DRN, in which the 9-10 y.o. are the most variable, adults and adolescents are the most variable during the last sessions. However, no significant differences between age groups for the experimental groups NNN and NRN are noted.

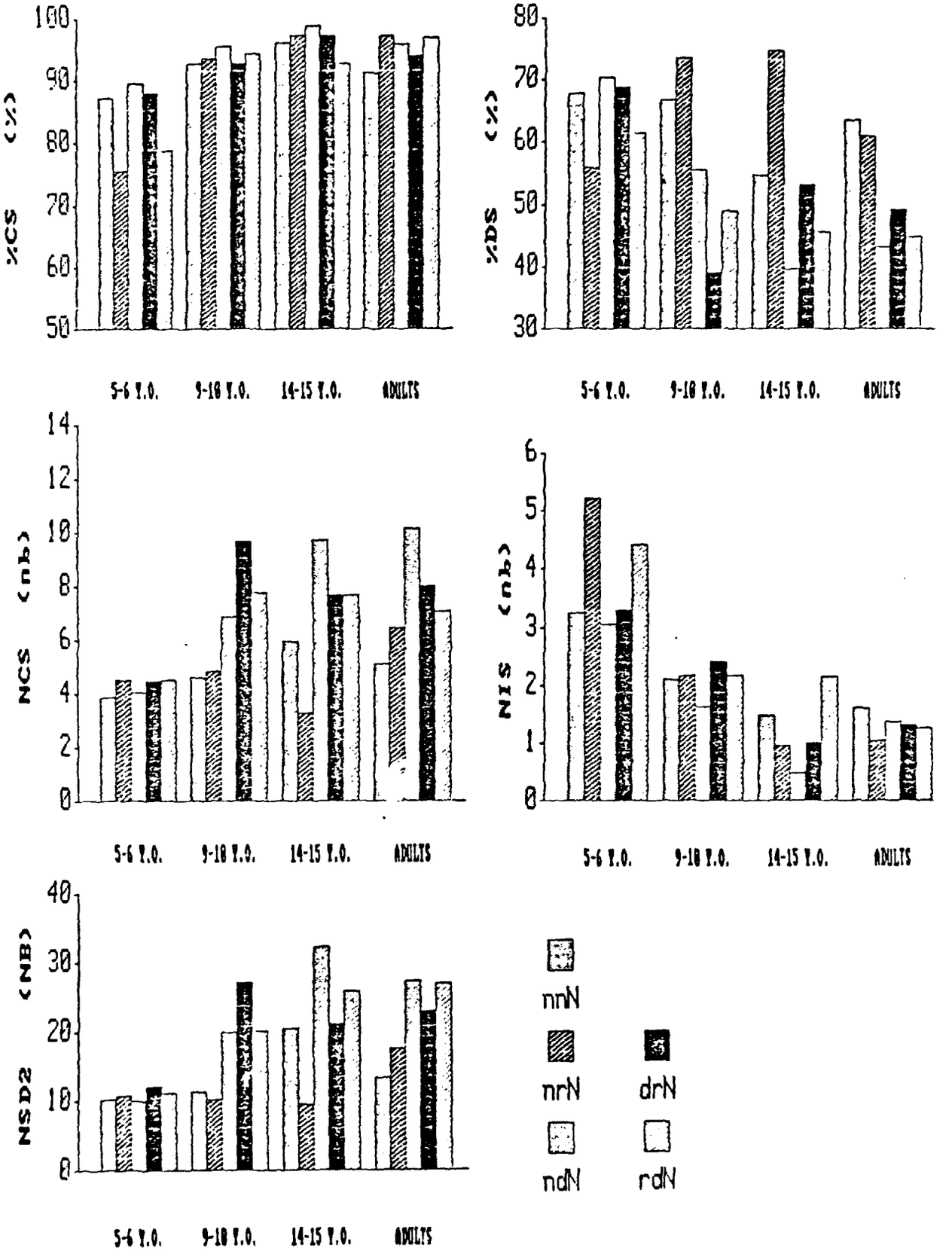

Fig. 18 : Mean values of performance and variability cues (%CS, %DS, NCS, NIS, NSD2) in N (third session) according to age and to pre-training type.

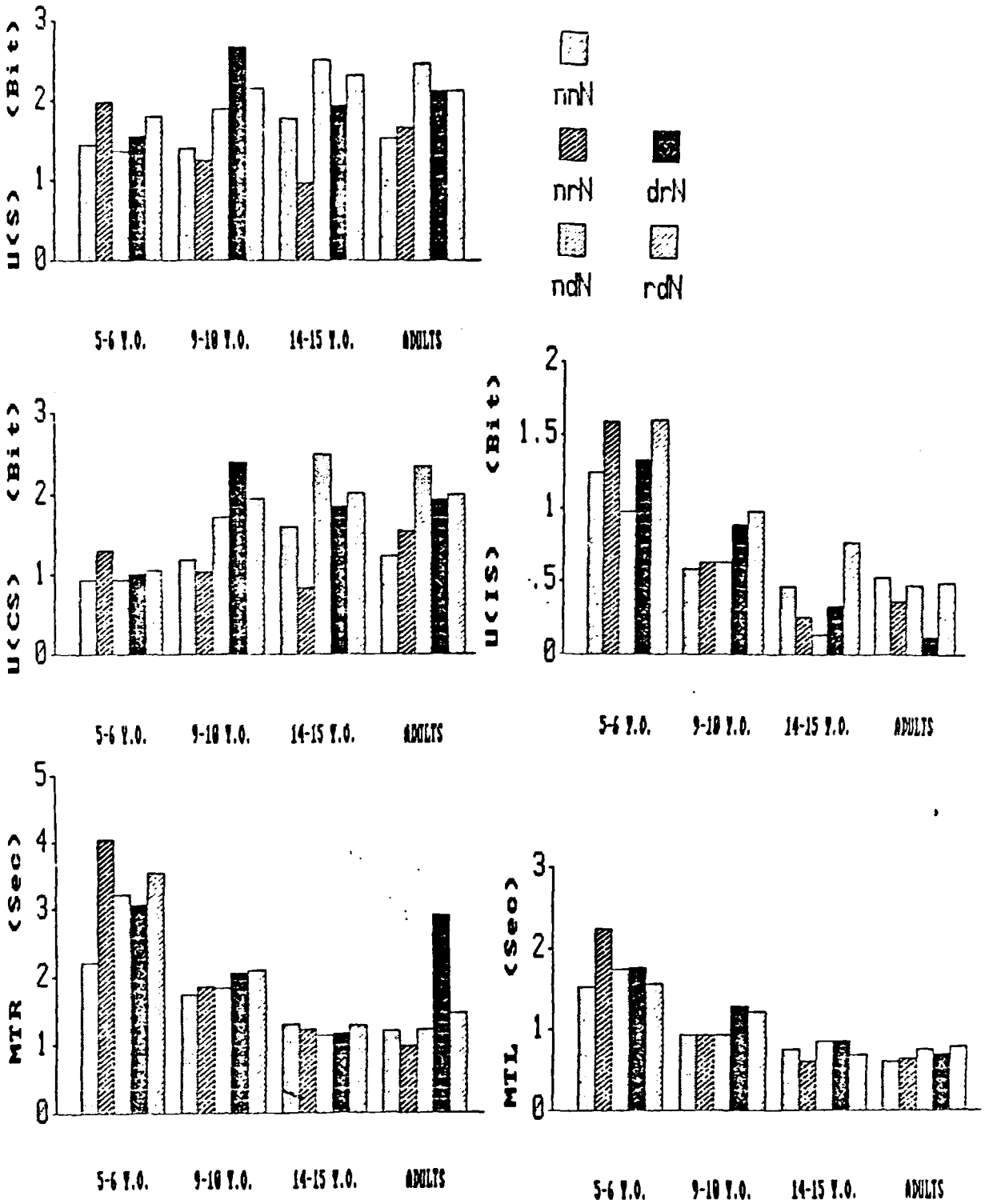

Fig. 19 : Mean values of performance and variability cues (U(S), U(CS), U(IS), MTR, MTL) in N (third session) according to age and to pre-training type.

3.1.2.2. Performance and variability according to sex and to matrix type or to experimental group*.

MTR and MTL are not taken into account, because results concerning these two cues evolve in too diverse lines.

a) N, R and D in first session :

- These is no significant sex effect among the 5-6y.o. and the 14-15y.o.

- Among the 9-10 y.o., the sex effect is significant for the % CS ($F(1,90)=4.544$, $p=.036$), for NIS ($F(1,90)=4.935$, $p=.029$) and for U(IS) ($F(1,90)=3.719$, $p=.057$) : for the three matrix types, the number and the variability of incorrect sequences are higher for boys than for girls. The 9-10 y.o. boys are thus less able performers and more variable in their

- The same phenomenon can be observed among the adults, for NIS ($F(1,99)=4.22$, $p=.04$) and for U(IS) ($F(1,99)=5.94$, $p=.02$). Moreover, NCS is here lower for girls than for boys ($F(1,99)=5.387$, $p=.02$) in N and in R. (this is particularly marked in N). This last difference does not exists in D. Girls show, thus, a tendency to be more stereotyped than boys, except when reinforcement contingencies require variability.

- There is no significant difference according to sex with regard to DS distributions.

b) N, R and D in second session :

No sex effect is observed.

c) N in third session :

The sex effect is significant only among the 14-15 y.o., but combined with an interaction effect sex x experimental group, for the following cues : the % CS (sex effect : ($F_S(1,97)=6,81$, $p=.011$; interaction effect :

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* Two-Way ANOVA have been used here .

($F_I(4,97)=4.534$, p=.002), NIS ($F_S(1,97)=8.761$, p=.004; $F_I(4,97)=4.753$, p=.002) and U(SI) ($F_S(1,97)=5.181$, p=.015; $F_I(4,97)=4.263$, p=.003). It appears that boys of experimental group RDN are less able performers and more variable in their errors than the girls as well as the other boys, in N in the third session. That does not allow us to conclude anything.

3.1.2.3. Performance and variability of adults, according to study type and to matrix type or to experimental group.*

No relation between study type (literary, neutral, scientific)**, performance and variability can be established in any group studied.

3.1.2.4. Intra-sequence organization : Conditional Uncertainty of each response, according to age and to matrix type***.

The conditional uncertainty of one response x is an evaluation of the possibility to predict x, according to the x-1 responses (pre-sequence s) already produced inside a sequence :

$$U(R_i/s) = -\sum_{i=1}^{2}\sum_{j=1}^{k} pi\ p(R_i/sj)\ \log_2 p(R_i/sj), \text{ with}$$

pi= the probability of the response i (R_i)

p (R_i/sj)= the conditional probability of R_i, according to the pre-sequence sj

k= the number of possible different pre-sequences i-1

For the first response, we calculate its uncertainty U(R1) because, in

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* Two-Way ANOVA

** A detailed list of study types can be found in annex p.16

*** Statistical tests used : ANOVA (F) and Newman-Keuls procedure. These tests were replaced by non-parametic tests : Kruskal-Wallis (X^2) and Mann-Whitney (U) when variances were not homogeneous and when groups sizes were too different.

this case, there is no pre-sequence.

The U(R1) and U(R/s) which are presented, are means calculated on the set of subjects' results in one session of one experimental group. Responses of correct and incorrect sequences are taken into account.

During the first session, for each matrix type (GN, R and D) and for each age group, we see a decrease of the responses conditional uncertainty U(R/s), from the first to the sixth response (see Figure 20, p.70).

It seems possible to distribute the six responses into two "units", the first one, grouping the first three responses, can be considered as the sequence element of variation; the second unit, grouping the last three responses can be viewed as the sequence element of regulation (to complete a correct sequence). $U(R_6/s)$ is never equal to zero, because there is always, at least, some incorrect sequences.

The curves form and the differences between age groups vary according to matrix type. Globally, U (R/s) reflects the results which have already been described (so, only the main effects will be underlined).

For the matrix N and for all the age group, U(R1) is not maximum and U(R/s) decreases rapidly, to tend to zero with the last response. U(R/s) is always the highest among the 5-6 y.o. for the last three responses (sequence element of regulation), parallel to their highest level of incorrect sequences.

U(R1), $U(R_2/s)$ and $U(R_3/s)$ are similar in N and in R for adults, but these subjects keep more variable behaviors in R for the last three responses (more incorrect responses.) We observe the reverse phenomenon in D : U(R1) is near the maximum and U(R/s) decreases more slowly with regards to the first three responses. Then it decreases more rapidly to reach the same $U(R_5/s)$ as in R and the same $U(R_6/s)$ as in N. The distinction between the two sequence units appears thus very clearly : subjects especially very at the beginning of the sequence, but are able to adjust their

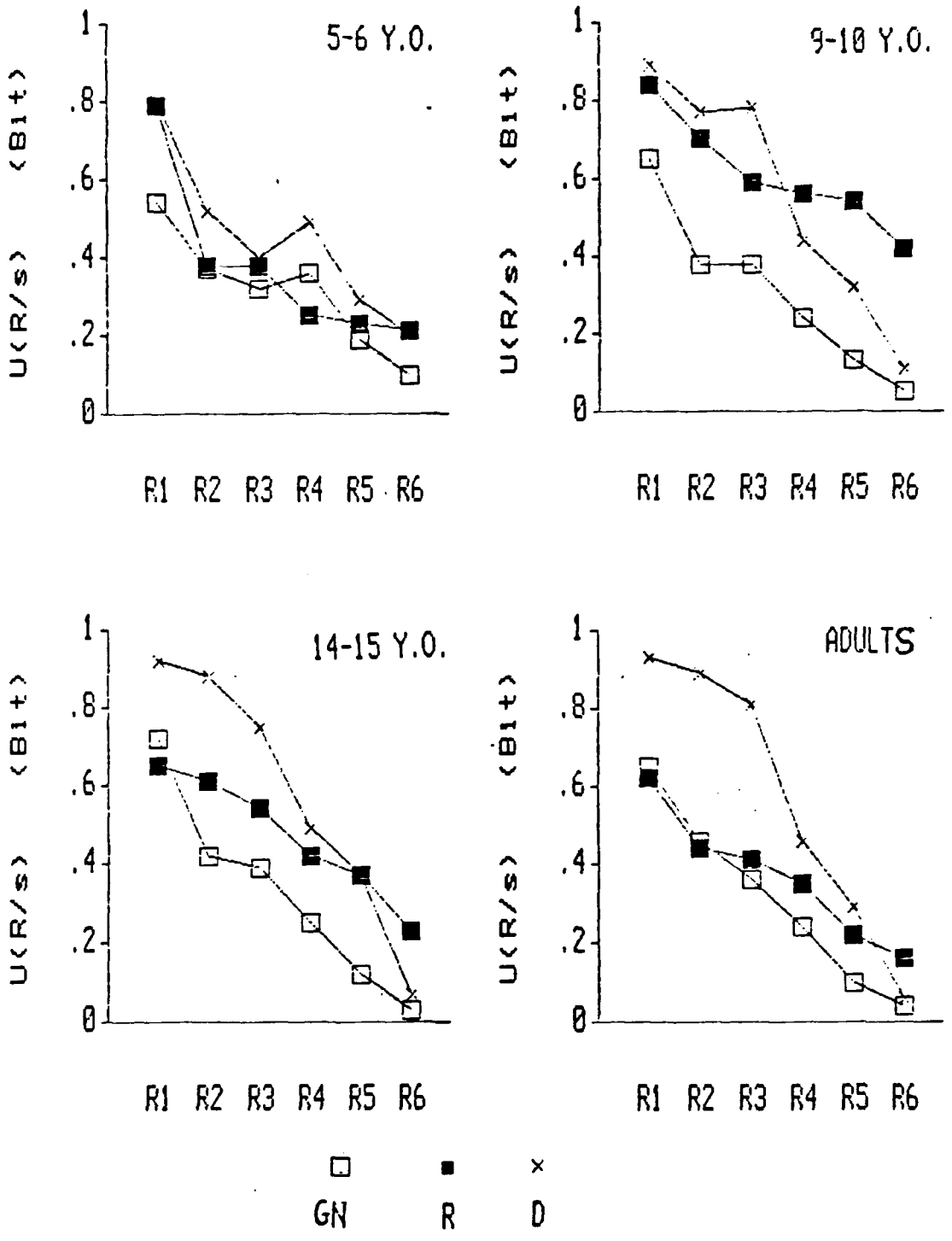

Fig. 20 : Mean values of U(R1) and U(R/s) in each age group, according to matrix type.

responses in the second sequence unit, to produce correct sequences.

Adolescents' behaviors are not fundamentally different from the adults'ones (they are just a little more variable in R).

The 9-10 y.o. are, on the contrary, as variable in R as in D up to R_4. They keep then high levels of U(P/s) for the last two responses, showing their incapacity to adjust their behaviors in this contingency. Their U(R1) and U(R/s) are always greater than those of the other subjects (this confirms our previous analyses).

After their first push, the 5-6 y.o. quickly become more stereotyped than the other subjects in R and in D. This goes in the same sense as their great % DS in R (diagonal sequences). In D, like in N, their U (R_6/s) stay higher than in the other age groups.

We do not present the U (R/s) for the second and the third sessions, because the results also agree with those already described. During the second session, differences between U (R/s), according to age and to experimental group, are generally similar to those observed in the first session but, often, less marked. During the last session, it appears that U (R_2/s), U (R_3/s) and U (R_4/s) of experimental group NNN and NRN, are the lowest (these two groups have also been considered before as the most stereotypy inductives).

3.1.2.5. Performance, variability and Dominant Sequence changes in NNN.

We have made this qualitative analysis to explore an hypothesis that has been suggested by a superficial examination of individual data : subjects who spontaneously change of DS (one or two times) in the experimental group NNN, seem to be really more variable than those who keep the same DS from the first to the last session.

It has not been made with the other experimental groups, because it

would have been difficult to evaluate the respective influences of the subject attitudes and of the matrix type, on DS changes. We do not use statistical tests here, because of the exploratory nature of this analysis and of limited number of subjects in some groups.

Age group	5-6 y.o.	9-10 y.o.	14-15 y.o.	Adults
n	15	20	17	21
n1	10	16	10	14
%	66.7	80.	58.8	66.7
n2	5	4	7	7
%	33.3	20	41.2	33.3

n1 = number of subjects who keep the same DS.
n2 = number of subjects who changes their DS.

Table 21 : Frequencies and percentage of DS changes according to age.

We have proceeded in the following way : in each age group, we have separated subjects who keep the same DS from subjects who change, at least one time, of DS. We have then recalculated the mean results, for each performance (except MTR and MTL) and variability cue, of these two sub-groups and we have compared it qualitatively on graphs.

In each age group, we see that it is a minority of subjects who change their DS during sessions. They are a bit more numerous among adolescents and a bit less among the 9-10 y.o.

Sub-group mean results, in each age group : (see fig. 22, 23, 24 and 25 , pp.74-75).

Results of adults, adolescents and 9-10 y.o. go in the same sense :
- there is no marked difference between subjects who change or not of DS, with regards to the performance (% CS) and with regards to the incorrect sequence variability (U (IS) and NIS).

- on the contrary, we observe relatively important differences between the two sub-groups in regards to the global variability (U'S) and % DS) and to the correct sequence variability (U(CS) and NCS). The greater variability of subjects who change of DS persist all along the three sessions. The behaviors of sub-groups show even a slight tendency to become more differentiated in the third session; subjects with the same DS becoming a bit more stereotyped and subjects with several DS becoming a bit more variable.

- for these three age groups, we may thus suppose that, for a same level of performance, some subjects, (a minority) would be spontaneously more variable than the other one and that this characteristic would remain quite constant. We pose here the problem of inter-individual differences, in the intra-individual behavioral variability context. That was not, of course, the aim of our study, but we think that further researches would be necessary to help to nuance the means on which we work.

The 5-6 y.o. results evolve in a different way. In the first session, the two sub-groups differ, as well for the performance (lower among subjects changing of DS) as for the variability (higher in any case for these subjects). But the behaviors of subjects who change their DS tend to meet these of "stable" subjects, in the second and in the third sessions. DS changes seem to be linked, among the 5-6 y.o., to problems of task comprehension and not as it was the case for the older subjects, to a spontaneous attitude to vary in a correct way.

After a certain habituation time to the task, necessary for some of them, the youngest subjects tend thus to behave all in the same manner. Inter-individual differences would only appear later in the ontogenetic development and would remain until adulthood.

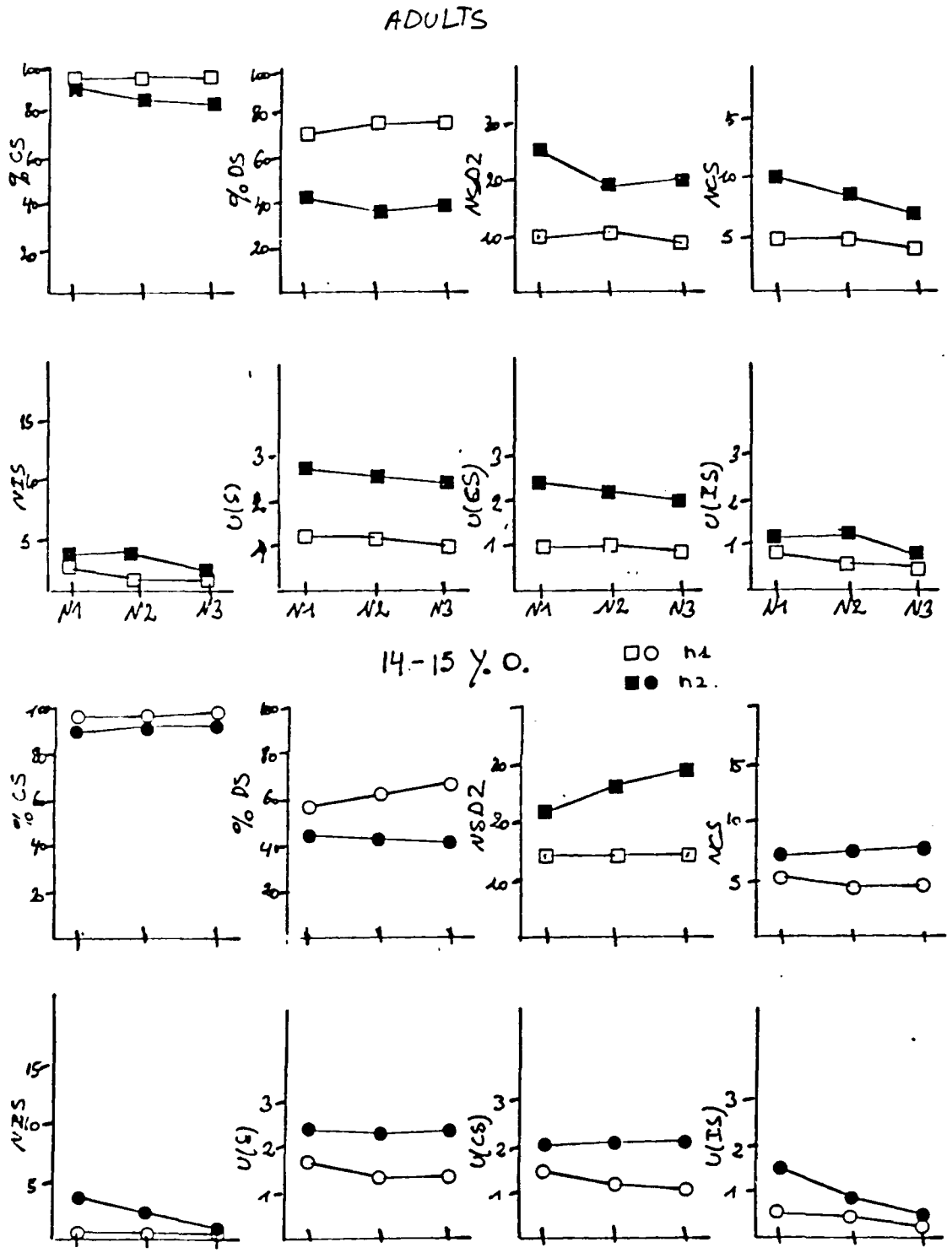

Fig. 22 : Mean values of performance and variability cues among ADULTS in NNN, according to DS change.

Fig. 23 : Mean values of performance and variability cues among 14-15 Y.O. in NNN, according to DS change.

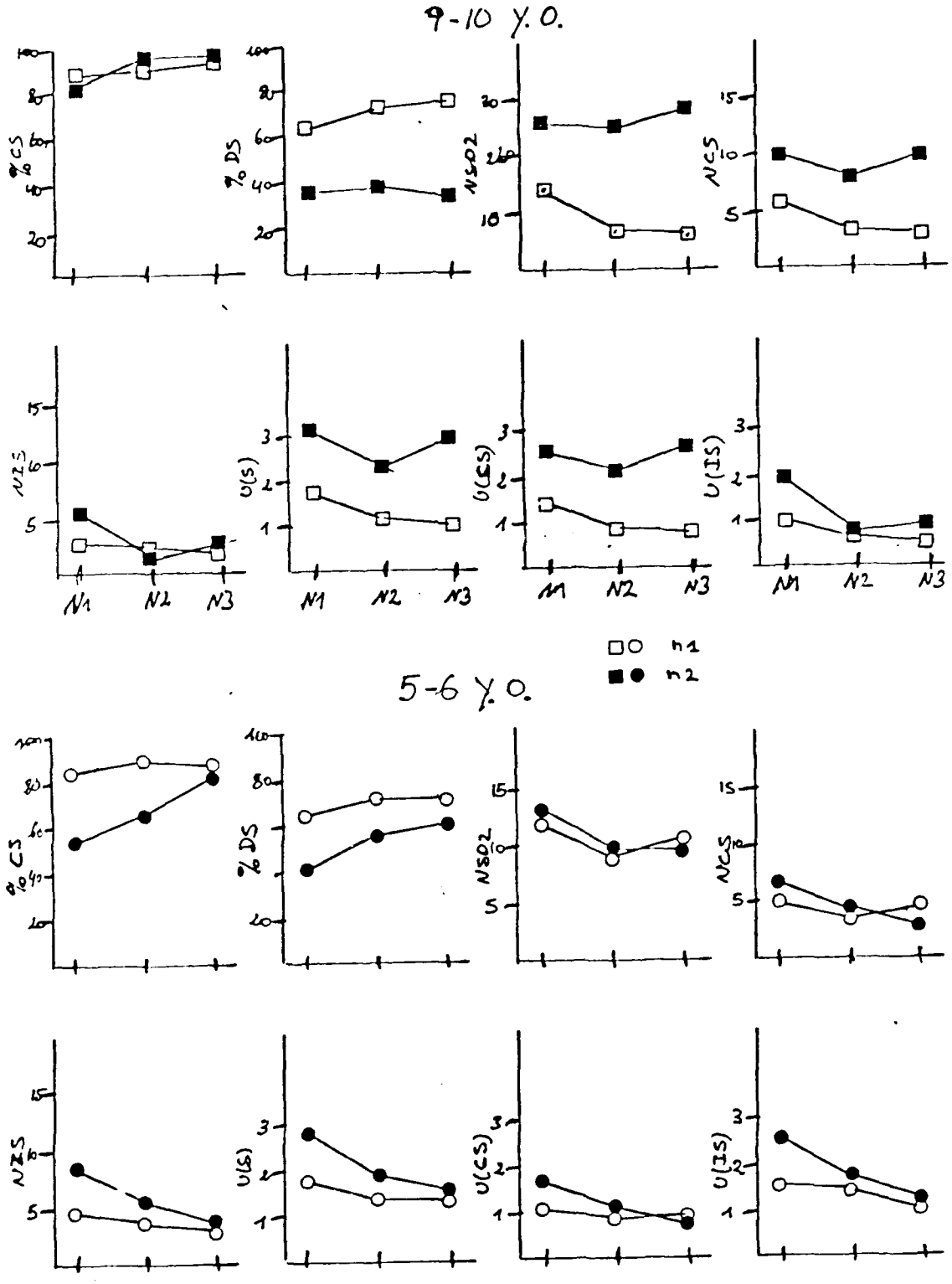

Fig. 24 : Mean values of performance and variability cues among 9-10 Y.O. in NNN, according to DS change.

Fig. 25 : Mean values of performance and variability cues among 5-6 Y.O. in NNN, according to DS change.

3.1.3. Conclusions of visual Matrix task Results.

We will first examine the influence of reinforcement contingencies, of visual feedbacks and of the experimental history, on the adults' and adolescents' behavioral variability. Then, we will see in which way the younger subjects' reactions differ from these of the older ones.

Globally, adults' and adolescents' behaviors show that they are sensitive to environmental factors.

In the normal situation (N), contingent reinforcement produces some stereotypy (subjects in N are the most stereotyped, in the first session), which still increases all along the three sessions. But it is important to note that the stereotypy never becomes complete (subjects always make several different correct sequences).

The random displacement of visual cues disturbs the two age groups and increases the incorrect sequence variability (as compared to N, in the first session). Subjects adjust less well their responses in the second part of sequences.

The investigation of the DS distribution can help us to evaluate the role of visual cues and their influence on the sequence form. When no coherent landmark is available, subjects prefer diagonal DS. This motive strategy is, in fact, the easiest way to solve the problem. When it is possible, in N and in D, it seems that subjects prefer to use the visual landmarks to adjust their responses (to avoid to get out of the matrix). So, we can say that visual cues help subjects to correctly organize their behaviors.

The experimental history influeces the reactions in R. The normal situation has a facilitation effect on the performance in R, showing that the visual cue incoherence takes less importances, when subjects have already understood the task. This facilitation effect is still more marked after D, in the first session (not significant) : a greater anterior correct variability would help subjects to find more early a satisfying solution in

R. When reinforcement contingencies demand it, adults and adolescents produce more variability (even a bit more than what is required). To adapt themselves to this constraint, they vary their first three responses arrangement and adjust the last three ones, to complete a correct sequence (good behavioral regulation).

We have not encountered marked effects of the experimental history on the reactions in D. But, a greater variability at a moment of the pre-training, tends to increase the variability in the normal session presented in the last session (pro-active effects of D), as it helps subjects to perform better in R.

The 9-10 y.o. are the most disrupted by the lack of visual landmarks and this leads to increase their variability (as well for incorrect as for correct sequences). If, asthe other subjects, they choose more often diagonal sequences as DS, they also have more erroneous DS. Given their greater variability and, thus, their lower %DS in R, we may suppose that the subjects who discover the motive strategy, do it later than in the other age groups (probably, after more researches). To make sure of this hypothesis, an analysis by block of trials (taking into account the evolution of behaviors) would be necessary.

As for adults and adolescents, a preliminary habituation to the normal task helps them to perform better in R, but the variability request during the first session does not.

It is more difficult to incite correct variability among the 9-10 y.o. and they succeed in only in part. They make more errors and they increase, in the same time, their incorrect sequence variability. We must mention here that the reactions with the matrixes R and D are less different than among the older subjects

When variability is required after N, they have still more problems to adapt their behaviors to this constraint. It does not seem easy for them to change their behaviors for more differentiated ones.

It is for the 5-6 y.o. that the visual cues have the least importance. They are, indeed, the best performers and the most stereotyped with R. The examination of the DS distribution reveals that 100% of these subjects have diagonal DS in R. Even with the other matrix types, they choose more often the motive strategy, as a means to solve the task without the necessity to understand what is going on. As it has already been remarked, they show, in that sense, a good behavioral adaptation for their young age. But, this strategy is not very useful for the adaptation to the variability constraint, since their behavior offers them few possibilities.

If their variability is a bit higher in D, this is probably attribuable, in this case, to the intermittence of reinforcement (respondant effect of the number of reinforcement decrease). The same remark can be done for some 9-10 y.o. subjects, at least.

The habituation to the task in the normal situation interferes with the subsequent preformance in R or in D.

In short, parallel to the increase of the performance and of the variability with age, it seems that the capacity to adopt adapted behaviors (more or less variable, but efficient) to the present environmental contingencies, also increases as a function of age.

This capacity appears low among the youngest subjects. It begins to appear among the 9-10 y.o. (they are sensitive to the variability constraint, but they do not really seem to understand how to vary their behaviors in an optimal way; they are aware of the incoherence of visual cues in R, but they are not able to do abstraction of it). On the other hand, the capacity to differentiate one's behaviors is well developed among adolescents and adults. The older subjects tend to better optimize their behaviors, according to the present situation (more stereotyped in N and in R, when variability is not necessary for reinforcement; more variable if variability must be produced).

3.2. Cognitive tasks.

3.2.1. Adult subjects (n=100).

1. Description of results for each "cognitive" task.

- Non-perceptive serial classification :

The mean number of sucessful items, on the 6 ones proposed, is 4.73 (σ=1.27). 61 % of adults correctly complete 5 or 6 items -37 % complete the totality of items (see Table 2.,p.88)*.

These results are similar to those obtained by Botson and Deliège (1976).

- Permutations :

70% of adults adopt a systematic procedure to execute the totality of permutations (with 3,4 and 5 elements), are able to underdstand the calculation principe and to apply it to any number of elements (see Table 3 'p.88).

Subjects are classified into 4 categories :

1. Subjects who do not understand the permutation calculation principle and who do not apply a systematic procedure to execute permutations.

2. Subjects who do not understand the permutation calculation principle and who adopt a systematic procedure to execute permutations, but not to the totality of it.

3. Subjects who do not understand the permutation calculation principle, but who adopt a systematic procedure to execute the totality of permutations.

4. Subjects who know the permutation calculation principle and who systematically execute the totality of permutations.

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*Procedures used by subjects in serial classifications will not be analyzed, because of methodological difficulties that have been met to code them in a reliable manner (to obtain more precisions, we could not question subjects about their strategies, because of possible pro-active effects on their performance).

- Group Empedded Figures Test (GEFT) :

With regard to the field dependence or independence (cognitive style), the mean correct item on the 16 items proposed at the GEFT is 13.95 (σ =3.69). This mean is approximatively the same as the mean (14) obtained by the subjects sample, that was used to standardize the French version of the test.

One third of adults can be considered as very field dependent (see Table 4, p.), as has already been observed in the other studies concerning this cognitive style, women are significantly more field dependent than men : 43.6 % of women succeed in 0 to 12 items, as compare to 21.3 % of men; only 23.1 % of women succeed in 17 or 18 items, as compare to 39.3 % of men (X^2 = 6.0758, DF = 2, p = .0479).

The study type is also significantly correlated to cognitive style (X^2 = 12.347, DF = 4, p = .0149) : 46.7 % of "Scientific" subjects succeed in 17 or 16 items, as compare to 22.2 % of "neutral" subjects and 21.1 % of "literary" subjects.*

Remark : there is no difference according to sex or to study type, in the two other cognitive tasks.

2. Relations between "cognitive" task results.

Correlations were used only when tasks results could be considered as measurable variables (so, not for permutations).

There is no significant relation between the number of serial classification suceeful items and the number of GEFT correct items.

3. Relations between "cognitive" tasks results and performance and variability cues (Metrix task).

We compare the two types of tasks from results of subjects who have been submitted to the metrix N in the first session (n=61).

One Way ANOVA and Neuman-Keuls Procedure were used for each

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* A detailed list of study types can be found in Annex , p 16

performance and variability cue, according to results obtained with each cognitive task (groups have been made from categories described in the presentation of cognitive tasks results). Correlations were also used when tasks results could be considered as measurable.

Remark : we do not compare the results of subjects who have had R or D in the first session, because of the limited number of subjects in some groups (for example : there are only 4 subjects, with D in the first session, who succeed in 3 or 4 serial classification items -second category).

For adults, there is no significant relation between their cognitive task results, on one hand, and their performance and their variability in N in first the session, on the other hand.

3.2.2. 14-15 y.o. subjects (n=98).

1. Description of results for each "cognitive" task.

- Classification tasks (Level II) :

For the spontaneous classification, subjects are separated into two categories. In the first one, we group subjects who spontaneously classify the objects into several juxtaposed under-collections, who divide the objects into 2 collections (one dichotomy) or who divide the objects into 2 collections, which are itselves divided into 2 under-collections. In the second category, we group subjects who spontaneously put together, by trials and errors, the different under-collections, according to their similarly (one multiplicative classification) or who directly execute a correct multiplicative classification; for example, the objects distribution can be represented as follow :

yellow circles	yellow squares
blue circles	blue squares

Only 27.6 % of adolescents spontaneously execute a multiplicative classification . In the second part of the task (imposed successive dichotomies), they realize, on average, 5.74 correct dichotomies (σ =.56) and, in the third part (imposed successive multiplicative multiplications), 6.66 correct multiplicative classifications (σ =3.22). 80.6% of these subjects execute the totality of the 6 possible dichotomies and 12.2% realize between 11 and 15 multiplicative classifications (see Table 5 ,p.88).

If 56.1% of the subjects adopt a systematic procedure to execute their multiplicative classifications (they choose one dichotomy criterion that they cross with the other ones and they do the same with a second as with a third... dichotomy criterion,...), 25.5% of the subjects seem to produce their different classification at random.

- non-perceptive serial classification :

The mean number of successfull items, on the 6 proposed, is 4.37 (σ = 1.46). 27% of adolescents correctly complete the totality of items (see Table 6,p.) to 37% of adults. However, subjects' distributions do not differ significantly (see Tables 1 and 5 ,p.88).

- permutations :

Adolescents are not good performers as the adults : only 32.7% of subjects (compared to 70% of adults) know the permutations calculation principle and are able to execute systematically the totality of permutations. Adults distribution (Table 2) and adolescents distribution (Table 7) are significantly different (X^2 = 30.4365, DF = 3, p = .000).

- GEFT :

Their mean correct items at the GEFT is 10.65 (σ = 4.70). Adolescents are significantly more field dependent than adults (see Table 8, p.89) (X^2 = 24.08, DF = 3, p = .000).

- There is no difference according to sex, in the four cognitive tasks.

2. Relations between "cognitive" tasks results.

The number of serial classification correct items is positively correleted with the number of correct dichotomies (ρ = .3930, $p \leq .001$) and with the number of GEFT correct items (ρ = .3003, p .01).

3. Relations between cognitive tasks results and performance and veriability cues.

Only the results of subjects who have been submitted to the matrix N in the first session are taken into account (n = 57).

The statistical analysis (same as for adults) do not reveal any significant relation between the adolescents' performance at each cognitive task, their performance and their veriability in N in the first session.

3.2.3. 9-10 y.o. subjects. (n = 91).

1. Description of results for each "cognitive" task.

- Multiplicative seriation task :

Subjects are separated into three categories (see Table 8). In the first one, we group subjects who arrange the elements according to only one dimension (length or color intensity) or who correctly complete the exemple. We group, in the second category, subjects who first arrange the elements, according to one dimension and who rearrange this first seriation, according to the second dimension. In the third category, we group subjects who arrenege the element according to the two dimensions, simultaneously.

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* - Level I classification task includes 8 elements, which can be dichotomized according to 7 criteria.

- Level II classification task includes 16 elements, which can be dichotomized according to 6 criteria.

A great majority of subjects can arrange the elements according to the two dimensions, but only successively.

- Classification tasks (Levels I and II) :

For the spontaneous classifications we use the same categories as those described for the 14-15 y.o. (see p.81) : 16.7% of the 9-10y.o. subjects spontaneously execute a multiplicative classification in the Level I task, compared to 16.5% in the Level II task (27.6% among the adolescents). Differences between the 9-10 y.o. and the 14-15 y.o. for the Level II task are not significant.

For the second and the third part of the task, subjects are distributed into two categories, according to the number of correct dichotomies and to the number of correct multiplicative classifications they have realized (maxima 3 and 3, for the Level I task; 6 and 15 foor the Level II task).

They realize on average, 2.5 dichotomies (σ = .70) and 1.98 multiplicative classifications (σ = 1.04), in the Level I task. 61.5% of subjects execute the totality of the three possible dichotomies and 39%, the totality of the three possible multiplicative classifications (compared to 69% of the 8-9 y.o. subjects observed by Piaget and Inhelder (1967, p. 211)).

In the Level II task, they realize an average of 5.26 dichotomies (σ = 1.00) and 3.65 multiplicative classifications (σ = 2.66) compared to 5.74 and 6.66 among the 14-15 y.o., respectively). 56% of subjects execute the totality of the 6 possible dichotomies and 2.2%, between 11 and 15 multiplicative classifications (see Table 10, p.83 compared to respectively, 60.6% and 12.2% among the 14-15 y.o.). Differences between the 9-10 y.o. and adolescents are here significant (X^2 = 12.1447, DF = 1, p= .0005, for the dichotomies number; X^2 = 34287, DF = 2, p = .000, for the multiplicative classifications number).

Girls realize a significantly higher number of Level II multiplicative classifications than boys : 66.9% of the girls execute from 0 to 5 correct

multiplicative classifications and 26.9% execute from 6 to 10, compared to 93.8% and 4.3%, respectively, for the boys (X^2 = 10.0028, DF = 2, p = .0067).

- Perceptive serial classification :

The mean of successfull items on the 3 ones proposed, is 2.04 (G= .94). 40.7% of subjects succeed in the totality of items (see Table II, p.85) in Botson and Deliège's results (1976), 30% of the 9 y.o. subjects and 60% of the 10 y.o. subjects succeed in the 3 items.

- Inclusion task :

Except one subject, all the others understand the inclusion notion.

2. Relations between "cognitive" task results.

The number of Level I correct dichotomies is positively correlated with the number of correct multiplicative classifications, realized on the same elements (ρ = .3081, $p \leq .01$). Performance at this task is itself positively correlated with the number of Level II correct multiplicative classifications (ρ = .5595, $p \leq .001$).

3. Relations between "cognitive" tasks results and performance and variability cues.

The results of 57 subjects with N in the first session are taken into account. As for the two other age groups, there is no significant relation between the 9-10 y.o. cognitive tasks results, their performance and their variability in N in the first session.

3.2.4. 5-6 y.o. subjects (n = 67).

1. Description of results for each "cognitive" task".

- Simple seriation task :

Subjects are separated into two categories. In the first one, we group

subjects who do not correctly arrange the elements (examples : they "drow" a house; they essemble the elements by two or by three; they form the top of stairs, but without taking into account the stairs basis). In the second category, we group subjects who realize a correct seriation (with or without the direct insertion of the remaining element).

44.3% of subjects go in the last category.

- Spontaneous classification (Level I) :

In a first time, we have used the same categorization principle as for the 9-10y.o. Only 9% of the 5-6 y.o. subjects succeed to spontaneously execute a multiplicative classification (18.7% for the 9-10 y.o.). Differences between age group are not significant.

In a second time, according to the behaviors, that have been observed, we have made two other categories, for the spontaneous classification :

1. We group subjects who do not spontaneously realize any classification (for exemple : they put the totality or a part of elements into a line; they essemble some elements to make a picture);

2. We group subjects who spontaneously execute several under-collections, one dichotomy or one multiplicative classification. In this way it is seen that 17.6% of the 5-6 y.o. subjects do not realize a real classification, while 82.2% of them succeed. Only 3.9% of the later subjects execute a multiplicative classification.

They make an average of 1.25 dichotomies (σ = .77) and .29 multiplicative classifications (σ = .558) (compared to 2.50 and 1.96, respectively, for the 9-10 y.o.).

Only 6% of them realize the totality of the 3 possible sichotomies and 1.5%, for the totality of the 3 possible multiplicative classifications (compared to 61.5% and 42.9%, respectively, for the 9-10 y.o.). Differences between the two age groups concerned are found to be significant (X^2 = 50.5863, DF = 1, p = .000, for the dichotomies number; X^2 = 34.921, DF = 1, p = .000 for the multiplicative classifications number).

64.6% of the youngest subjects make 0 or 1 dichotomy, while 35.4% make 2 or 3 dichotomies. 74.7% do not realize any correct multiplicative classification while 25.3% execute 1,2 or 3 correct multiplicative classifications.

- Perceptive serial classification :

The mean number of successfull items, on the 3 ones proposed, is 1.0 (σ = 1.01) (2.04 for the 9-10 y.o.). Only 10.4% of subjects succeed in the totality of items (compared to 40.7% of the 9-10 y.o.). the youngest subjects performance is thus significantly different from that of the 9-10 y.o. ($X2 = 20.827$, DF = 2, $p = .000$).

Subjects' distribution according to the number of successful items, has been established with other categorization criteria, as those of the 9-10 y.o. (see table 12 , p. 89) .

- Inclusion task :

Only one subject understand the inclusion notion.

- There is no difference according to sex, in the 4 cognitive tasks.

2. Relations between "cognitive" task results.

The number of correct dichotomies is positively correlated with the number of multiplicative classifications ($\rho = .3013$, $p \leq .01$) and with the number of correct items, at the perceptive serial classification ($\rho = .5059$, $p \leq .001$).

3. Relations between "cognitive" task results and performance and variability cues.

The results of 49 subjects with N in the first session are considered.

As for the three other age groups, there is no significant relation between the 5-6 y.o. cognitive tasks results, their performance and their variability in N in first session.

	ADULTS N=100
0-2	6
	6.00
3-4	33
	33
5-6	61
	61

TABLE 2

	ADULTS N=100
1	7
	7.00
2	7
	7
3	16
	16
4	70
	70

TABLE 3

	ADULTS N=100
0-12	30
	30.00
13-16	37
	37
17-18	33
	33

TABLE 4

	14-15 Y.O N=98
0-5	39
	39.80
6-10	47
	48
11-15	12
	12.20

TABLE 5

	14-15 Y.O N=98
0-2	11
	11.20
3-4	33
	33.70
5-6	54
	55.10

TABLE 6

	14-15 Y.O N=98
1	28
	28.60
2	12
	12.20
3	26
	26.50
4	32
	32.70

TABLE 7

Table 2 : Adults' frequencies and percentages according to the number of correct items at the non-perceptive serial classification task.

Table 3 : Adults' frequencies and percentages according to the performance in the permutation task.

Table 4 : Adults' frequencies and percentages according to the number of correct items at the GEFT.

Table 5 : 14-15 Y.O. frequencies and percentages according to the number of correct multiplicative classifications (level II).

Table 6 : 14-15 Y.O. frequencies and percentages according to the number of correct items at the non-perceptive serial classification task.

Table 7 : 14-15 Y.O. frequencies and percentages according to the performance in the permutation task.

	14-15 Y.O. N=98
0-12	58 59.10
13-16	31 31.60
17-18	9 9.20

TABLE 8

	9-10 Y.O. N=91
1	8 8.80
2	62 68.10
3	21 23.10

TABLE 9

	9-10 Y.O. N=91
0-5	74 81.30
6-10	15 16.50
11-15	2 2.20

TABLE 10

	9-10 Y.O. N=91
0-1	28 30.80
2	26 28.60
3	37 40.70

TABLE 11

	5-6 Y.O. N=67
0-1	41 61.20
2	19 28.40
3	7 10.40

TABLE 12

Table 8 : 14-15 Y.O. frequencies and percentages according to the number of correct items at the GEFT.

Table 9 : 9-10 Y.O. frequencies and percentages according to the performance in the multiplicative seriation task.

Table 10 : 9-10 Y.O. frequencies and percentages according to the number of correct multiplicative classifications (level II).

Table 11 : 9-10 Y.O. frequencies and percentages according to the number of correct items at the perceptive serial classification task.

Table 12 : 5-6 Y.O. frequencies and percentages according to the number of correct items at the perceptive serial classification task.

2.5 Conclusions of "cognitive" tasks results.

The evolution of the logico-mathematical thought, according to age, is attested to by the "cognitive" tasks results. They seem to reflect well the capacities of "abstractness" and of anticipation, as well as the mobility of thought, specific to each age group.

Classification tasks (successive dichotomies and successive multiplicative classifications) show that the mobility of thought and the capacities of anticipation and of "abstractness" (in other words, the subjects' capacity to consider all the possible classification criteria, the capacity to successively modify their arrangement according to these criteria, and the capacity to take simultaneously into account two criteria of a same element) increase as a function of age (5-6 y.o; to 14-15 y.o;). Seriation tasks give the same results, for the 5-6 y.o. and the 9-10 y.o.

Thus, we encounter a parallel evolution of operative capacities in two of the elementary logical structures (classification and seriation), as described by Piaget and Inhelder (1967).

The acquisition of these capacities mark the subjects' accession to the concrete operative stage, as does the comprehension of the inclusion quantification (the quasi totality of our 9-10 y.o. subject understand it).

The performances obtained with the perceptive serial classification task confirm these observations (the 9-10 y.o. are able to consider simultaneously several classification criteria, while it is the case only for some 5-6 y.o.)

Classification task of Level II indicates that the mobility of thought still increases among the 14-15 y.o. But the non-perceptive serial classification task show that it stays at a similar level among adults. The capacity to test hypotheses also reachs its quasi-maximum level among adolescents.

However, adults and adolescents differ in the permutation task. Adults

are better performers in this formal type task, implying the capacity to make operations on operations and the capacity to consider in thought all the possible combinations (combinatory operations). Adolescents would not sufficiently master the Formal Logic to imagine the totality of the possible relations between the elements of a system.

With regards to the cognitive styles, the 14-15 y.o. are more field dependent than adults. In the two age-groups, females are more field dependent than males. The analytic attitude in a problem solving task would be more developed among adults and, particularly, among males.

No significant relation between the subjects' cognitive capacities, and their performance and variability at the Visual Matrix task (with the matrix M in the first session), has been found, even if both, cognitive capacities and behavioral variability, evolve as a function of age.

The capacity to vary his behavior is surely limited by the subjects' general developmental level and it can not confused with his cognitive capacities.

In conclusion, we want thus to underline that the variability is an inherent characteristic of behavior and that it must viewed as a full topic for Psychology.

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APPENDIX A

"COGNITIVE" TASKS DESCRIPTION

"Cognitive" Tasks Description

A. Nursery school subjects.

1. Simple seriation and intercalation. (based on Piaget).

Material : 6 wooden sticks of graduated lenght (5 cm-10 cm).

Procedure : 1°. The 9 cm stick is taken away. The task is to seriate the other five according to lenght

2°. If seriation is correct, the child is asked to intercalate the missing stick in the correct position.

Actual performance of the task (and the procedures employed by the child) are recorded.

2. Free, dichotomic and multiplicative classifications (level 1 : 3 criteria of dichotomy). (based on Piaget).

Material : - 8 elements that can be sorted on the basis of size (7 x 7 cm and 7 cm Ø; 3,5 x 3,5 cm and 3,5 cm Ø), color (blue; yellow), or shape (disk; square).

- A sheet of paper which can be divided in 2 or 4 parts with two removable partitions.

Procedure : 1° Free classifications.

- All the elements are placed in disorderly manner on the table in front of the child.

- The child is asked to group the elements in any way he/she wishes to.

Instruction : "You see, these pieces are all mixed up, could you set in order them putting together those that are alike ?"

- After his/her first arrangement, the child is asked to carry out another classification.

Instruction : "Could you set in order the pieces again, but in another way,
---------- always putting together those that are alike ?"

2° Dichotomies.

- The elements are mixed up and the sheet of paper (divided in 2 parts) is placed right in front of the child.

- The child is asked to distribute the elements in two sets.

Instruction : "Could you arrange the pieces by making only two sets ?"

- Finally, he/she is asked to make yet 2 different dichotomies.

3° Multiplicative classifications.

- The elements are mixed together and the sheet of paper is divided in 4 parts by two removable partitions.

- The child is asked to distribute the elements in 4 sets.

Instruction : "Would you arrange these pieces in 4 sets; if one takes this
---------- partition (vertical) off, these sets (experimenter designates sets) must fit together, and if one takes this other partition (horizontal) off, these other 2 sets must fit too (designates).

- As for the dichotomies, the child is asked to make two additional multiplicative classifications.

- The child is asked to justify each of his/her performances.

- Actual performances of the task, the procedures employed by the child and his/her justifications are recorded.

3. Inclusion Quantification. (based on Piaget)

Material : 7 paper disks (3.5 cm Ø) : 5 blue and 2 yellow.

- Inclusion question : "You see, they are all paper disks, there are some yellow and some blue disks. Could you tell me if there are more paper disks or more blue disks".
- The child is requested to justify his/her answer.

4. Perceptive serial classification (developed by Botson and Deliège, 1976).

The task is composed of 4 items (the first, is a training item)

Each series can be dichotomized at each point according the following properties : (photographies of the material can be found in the second progress report, march 1986, annex 2, pp 10-11).

Training item.

Spheric / angular
smooth / rough
thick / thin
colorless / colored

Item 1.

Thick / thin
Rough / Smooth
Red / Blue
Large / Small
Rectangular / Triangular
Opeque / Transparent

Item 2 :

Thick / Thin
Pierced / Whole
Square / Round
Red / Yellow
Rough / Smooth

Item 3 :

Colored / Colorless
Angular / Round
Volume / Flat
White / Pierced

Procedure :

- For each item, the subject is presented with an array of objects varying along several dimensions. His/her task is to set in order the objects in such a way that at any point, the series can be dichotomically cut, with the objects on one side sharing a common property, but lacking an additional one shared by the objects on the other side.

Instruction : "Here are the objects you will order in a row, one after the other, but paying attention to the sequence in which you do it. You choose first, the one that is different from all the others for whatever reason."
"Then, you choose another one so that the first two go together and are different from all the ones left for whatever reason."
"You choose another one so that the first three go together and are different from all the ones left for whatever reason".

Etc...

-After the construction of each series the child is asked to justify each dichotomy.

Instruction : "Tell me what makes the first object different from all the others; tell me what makes the first two objects different from all the others; etc..."

- If a series is incorrect, the experimenter corrects it and the child is asked to justify each dichotomy again. If he/she cannot do it, correct justifications are given by the experimenter to the child.

- For each item, the series constructed by the child and all justifications he/she proposes are recorded.

5) Elementary school children : 4 tasks.

1. Multiplicative seriation. (based on Piaget)

Material : 7 x 7 sticks that can be seriated on the basis of size (7 graduated sizes : 4 cm-10 cm) and color intensity (7 graduated color intensities for 7 sticks of a determined length).

Procedure : 1° The task is to seriate all the 49 sticks according both to size and color intensity.

Instruction : " You see these sticks, they are of different sizes and color intensities. Could you set them in order ? Do as you please".

- If subject does not understand the instruction, he/she is instructed to set all the wooden sticks in order both from the smallest to the longest, and from the lightest to the darkest.

- If subject can not carry out his/her seriation the experimenter begin the seriation and the subject is asked to complete it.

2° If seriation is correct (with or without the example), the child is asked to find a certain stick which has both a particular color intensity and a particular size.

Actual performances of the task, and the procedures employed by the child are recorded.

2. Free, dichotomic and multiplicative classifications.

a) Level 1 : 3 criteria of dichotomy.

- Material, procedure and instructions are exactly the same as for Nursery school subjects (described above).

b) Level 2 : 6 criteria of dichotomy.

- Material : 16 geometrical forms. The characteristics of the elements are determinated as a function of 6 criteria of dichotomy : round/square; blue/yellow; large/small; thin/thick; pierced/whole; striped/stripeless. There are always 6 elements for each component of the corresponding dichotomy.

- Procedure and instructions are similar to those which are used for the level 1 classifications.
- But, with this second material, the child can carry out 6 different dichotomies and 15 different multiplicative classifications. So, he/she is asked to modify his/her dichotomy (or multiplicative classification) as many times as he/she can. The experimenter stops requesting modifications when the child makes 3 sucessive mistakes or repeats 3 times in a row a dichotomy (or multiplicative classification) he/she has already carried out, or when his/her reflexion times is longer than 3 minutes.
- To avoid the problems of memory, child is given a photography of each classification he/she has already made.

Actual performances, procedures employed by the child and his/her justifications are recorded

3. Inclusion quantification

Material, procedure and instructions : identical as those for nursery school children (described above).

4. Perceptive serial classifications.

Material, procedure and instructions : identical as those for nursery school children (described above).

C. Secondary school subjects.

1. Free, dichotomic and multiplicative classifications : only the level 2 classifications.

Material, procedure and instuctions : as described for elementary school children.

2. Non-perceptive serial classifications (developed by Botson and Deliège, 1976).

The task consists of 8 items (first and second are training items).

Photographies of the material can be found in the Second Progress Report, march 1986 Annex 2, pp 15-19)

Training item 1.

smooth / rough

square / round

blue / red

Training item 2.

(Whole / pierced)

Red / blue

Square / round

The correct element which complete the series is round, blue and pierced The characteristic which differentiates this element from the other ones is the fact that it is pierced (the 3 other elements are whole).

Item 1.

(Large / small)
Square / round
Blue / red

The correct element is red, round and small (all the other elements of the series are large).

Item 2.

Flat / Volume
Rectangular / Round
Opaque / transparent

The correct element is transparent, round and it is a volume (the other elements of the series are flat).

Item 3.

Flat / volume
Rectangular / Round
Blue / Red

The correct element is red, round and it is a volume (the other elements of the series are flat).

Item 4.

Thin / Thick
Rectangular / Round
Opaque / Transparent

The correct element is transparent, round and thick (the other elements of the series are thin)

Item 5.

Opaque / Transparent
Yellow / White
Round / angular

Item 6.

Smooth / Rough
Opaque / Transparent
Round / Angular
Pierced / whole

The element wich must be inserted into the series is round, whole, opaque and smooth

Procedure : 1° First training item.

Subject is presented with an array of 4 objects that vary along several dimensions. His/her task is to set in order the objects in such a way that at any point, the series can be dichotomically cut, with objects on one side sharing a common property, but lacking an additional property shared by the objects on the other side.

Instructions : "These elements are all unlike each other. You will set them in an order that I shall explain to you. You choose first, the element that is different from all the others on one of his characteristics..., you choose the second one so that the first two share a common property which opposes them to all the others..., you choose the third one so that the first three share a common property which opposes them to all the others, etc...You will verify that, at any point, the arrangement is correct before you say that you have finished it."

2° Second training item.

- On a first occasion, the subject is presented with an array of three objects and his/her task is to set in order these objects (as in the first training item).

- The second time, the subject is presented with 6 other objects and his/her task is to select the object that completes the series adequately.

instuction : "Now you will choose among these elements one which can be placed at the end of the row, so that the series remains correct. It is necessary that no matter where we cut, we will still be able to find a difference between all the elements at left, and all those at right".

3° Item 1 to item 6

- Subject's task is to complete the series by inserting, at a given point, the appropriate object (at the end of the series for items 1 to 4, and between 2 objects for items 5 and 6).

instructions : Similar to these ones proposed at the second demonstration item.

- For each item, after the object has been chosen, the subject is asked to justify all the dichotomies of the series.
- When the chosen object is not appropriate, the experimenter gives the subject the appropriate one and explains all the dichotomies.
- For each item, the chosen object and justifications are recorded.

3. Permutations (based on Piaget).

Material : 4 disks : 1 blue, 1 red, 1 yellow and 1 green.

Procedure : 1° Three disks are placed in line in front of the subject.

a) The subject is asked to find the number of permutations which are possible with 3 disks and to tell how he/she has found this number.

Instructions : - "How many different permutations can you do with these 3 disks ?"
- " How did you find this number ?"

b) Afterwards, the subject is asked to write the different permutations on paper.

2° The subject must find and justify the number of permutations with 4 disks and finally, with 5 disks.

4 "Group Embedded Figures Test" : Field-dependent and field-independent cognitive styles.

- The french version of the "Group Embedded Figures Test" (OLTMAN, RASKIN and WITKIN, 1971) shall be employed ("Test des Figures encastrées", published by : Les Editions du Centre de Psychologie Appliquée, Paris, France, 1965).
- This test consists of complex figures in which the subject has to recognize a simple figure. When the subject has found it, he/she traces their outlines with precision and as fast as possible.

There are three parts : the first part is composed of 7 items; it constitues a training exercise. Each of the others two parts are composed of 9 items. The time limit is, respectively, for the 3 parts; of 2; 5 and 5 minutes.

D. Adult subjects.

1. Non-perceptive serial classifications.
2. Permutations.
3. "Group Embedded Figures Test".

For each task, same material, procedure and instructions are used as for secondary school subjects.

APPENDIX B

LIST OF TABLES

TABLE 17 : U(S): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

TABLE 18 : U(CS): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

TABLE 19 : U(IS): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

TABLE 20 : MTR): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

TABLE 21 : MTL: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

TABLE 22 : Means of U(R1) and U(R/s) according to age and to matrix type, in the first session.

TABLE 23 : %CS, %DS, NCS, NIS, NSD2: ANOVA (age x matrix) in the first and in the second sessions (after N).

TABLE 24 : U(S), U(CS), U(IS), MTR, MTL: ANOVA (age x matrix) in the first and in the second sessions (after N).

TABLE 25 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (matrix) and Newman-Keuls test among the 5-6 Y.O., in the first session.
- Kruskal-Wallis (matrix) and Mann-Wihtney tests among 9-10 Y.O., 14-15 Y.O., ADULTS, in the first session.
(*) indicates a significant difference with P<.05.

TABLE 26 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (matrix) and Newman-Keuls test among the 5-6 Y.O., in the first session.
- Kruskal-Wallis (matrix) and Mann-Wihtney tests among 9-10 Y.O., 14-15 Y.O., ADULTS, in the first session.
(*) indicates a significant difference with P<.05.

TABLE 27 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (matrix) and Newman-Keuls test for each age group, in the first session.
(*) indicates a significant difference with P<.05.

TABLE 28 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (matrix) and Newman-Keuls test for each age group, in the first session.
(*) indicates a significant difference with P<.05.

TABLE 29 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (age x pre-training)in the third session.

TABLE 30 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (age x pre-training) in the third session.

TABLE 31 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (pre-training) and Newman-Keuls test for each age group, in the third session.
(*) indicates a significant difference with P<.05.

TABLE 32 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (pre-training) and Newman-Keuls test for each age group, in the third session.
(*) indicates a significant difference with P<.05.

TABLE 33 : %CS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 34 : %DS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 35 : NCS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 36 : NIS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 37 : NSD2 : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 38 : U(S) : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 39 : U(CS) : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 40 : U(IS) : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 41 : MTR : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

TABLE 42 : MTL : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

APPENDIX C

TABLES

1 SCIENTIFIC	BIOLOGY COMPUTER SCIENCE ECONOMICS ENGINEER GEOGRAPHY MEDECINE PHARMACOLOGY VETERINARY SURGEON PHYSIOTHERAPY
2 NEUTRAL	BUSINESS ADMINISTRATION PSYCHOLOGY UNSPECIFIED
3 LITERARY	JOURNALISM LANGUAGES LAW LITERARY PHILOSOPHY HISTORY

TABLE 1 : DETAILED LIST OF STUDY TYPES

MEANS - % CORRECT SEQUENCES (%CS)						
	N	N	N	N	R	N
5-6 Y.O.	74.53	81.73	87.20	75.22	58.66	75.55
9-10 Y.O.	87.20	94.26	92.90	93.88	67.55	93.77
14-15 Y.O.	93.00	95.29	96.23	93.70	80.11	97.40
ADULTES	94.20	93.33	91.52	91.60	80.50	97.50
	N	D	N	D	R	N
5-6 Y.O.	81.50	86.87	89.62	76.92	73.69	88.15
9-10 Y.O.	88	91.15	95.75	89	61.41	92.82
14-15 Y.O.	94.90	96.75	99.05	92.50	86.28	97.42
ADULTES	91.70	96.84	96.10	91.80	82.20	94.10
	R	D	N			
5-6 Y.O.	78.30	71.17	78.82			
9-10 Y.O.	51.50	82.82	94.58			
14-15 Y.O.	65.60	87.52	92.87			
ADULTES	75.70	93.26	97.17			

STANDARD DEVIATIONS - % CORRECT SEQUENCES (%CS)						
	N	N	N	N	R	N
5-6 Y.O.	26.12	24.34	10.97	22.10	29.16	29.26
9-10 Y.O.	17.91	19.27	17.13	5.70	19.44	13.73
14-15 Y.O.	6.40	5.47	4.40	9.30	19.76	2.68
ADULTES	4.70	8.61	21.19	11.00	20.04	3.66
	N	D	N	D	R	N
5-6 Y.O.	19.10	9.90	14.08	19.90	20.04	10.08
9-10 Y.O.	9.10	5.89	3.76	7.40	18.62	7.71
14-15 Y.O.	4.20	2.76	1.68	6.60	19.38	3.64
ADULTES	8.90	3.69	5.21	13.70	10.23	20.79
	R	D	N			
5-6 Y.O.	20.60	24.76	18.64			
9-10 Y.O.	18.10	13.49	4.62			
14-15 Y.O.	15.50	14.16	11.03			
ADULTES	17.70	4.72	3.60			

Table 2 : % correct sequences : means and standard deviations, according to experimental group and to age.

MEANS - % DOMINANT SEQUENCES (%DS)						
	N	N	N	N	R	N
5-6 Y.O.	57.06	67.46	67.86	54.77	44.11	55.88
9-10 Y.O.	57.70	64.80	66.80	59.88	45.44	73.77
14-15 Y.O.	52.70	54.58	54.70	55.80	59.20	74.80
ADULTES	61.23	62.47	63.71	57.30	51.60	61.10
	N	D	N	D	R	N
5-6 Y.O.	70.12	49.50	70.50	36.92	50.46	68.92
9-10 Y.O.	61.15	33.36	55.57	23.88	36.94	38.94
14-15 Y.O.	52	20.52	39.47	20.57	62.66	53.04
ADULTES	54	21.80	43.20	20.70	61.80	49.10
	R	D	N			
5-6 Y.O.	49.52	40.94	61.52			
9-10 Y.O.	27.41	31.17	48.82			
14-15 Y.O.	46	24.47	45.52			
ADULTES	57.78	28.52	44.73			
STANDARD DEVIATIONS - % DOMINANT SEQUENCES (%DS)						
	N	N	N	N	R	N
5-6 Y.O.	22.70	21.13	25.47	23.00	23.26	23.21
9-10 Y.O.	24.20	27.13	27.83	23.00	24.29	26.11
14-15 Y.O.	27.90	25.93	26.84	20.70	24.98	21.89
ADULTES	26.10	27.47	28.49	24.00	24.00	33.10
	N	D	N	D	R	N
5-6 Y.O.	24.40	16.00	28.83	18.50	20.88	16.07
9-10 Y.O.	22.30	12.77	27.87	11.40	21.17	23.14
14-15 Y.O.	25.50	6.38	29.86	7.20	21.85	30.54
ADULTES	26.40	11.19	33.29	5.90	18.72	29.11
	R	D	N			
5-6 Y.O.	18.70	18.33	24.30			
9-10 Y.O.	13.30	17.90	25.94			
14-15 Y.O.	21.80	9.14	28.50			
ADULTES	20.30	10.82	26.71			

Table 3 : % dominant sequences : means and standard deviations, according to experimental group and to age.

MEANS - NB. CORRECT DIFFERENT SEQUENCES (NCS)						
	N	N	N	N	R	N
5-6 Y.O.	5.40	3.93	3.86	5.11	5.72	4.50
9-10 Y.O.	6.70	4.20	4.60	5.77	6.94	4.83
14-15 Y.O.	6.40	5.76	5.94	6.20	5.35	3.25
ADULTES	6.70	6.00	5.09	6.05	6.80	6.45
	N	D	N	D	R	N
5-6 Y.O.	3.43	5.25	4.06	6.61	5.76	4.46
9-10 Y.O.	5.26	8.57	6.89	11.41	7.70	9.70
14-15 Y.O.	8.10	13.63	9.73	13.33	4.47	7.66
ADULTES	7.20	13.55	10.15	13.05	4.60	8
	R	D	N			
5-6 Y.O.	5.41	5.82	4.52			
9-10 Y.O.	8.23	9.58	7.76			
14-15 Y.O.	6.47	10.47	7.70			
ADULTES	5.15	8.89	7.05			
STANDARD DEVIATIONS - NB. CORRECT DIFFERENT SEQUENCES (NCS)						
	N	N	N	N	R	N
5-6 Y.O.	3.10	2.57	2.77	3.10	3.44	2.43
9-10 Y.O.	3.90	3.20	3.73	3.30	2.87	3.97
14-15 Y.O.	3.90	3.45	3.05	4.40	2.58	2.22
ADULTES	4.40	4.40	4.01	3.80	3.95	5.48
	N	D	N	D	R	N
5-6 Y.O.	2.30	2.72	3.29	3.30	3.03	2.56
9-10 Y.O.	2.50	3.18	4.79	4.40	2.99	4.42
14-15 Y.O.	5.00	2.58	4.95	3.70	1.66	5.75
ADULTES	4.10	4.46	6.22	3.90	2.47	6.38
	R	D	N			
5-6 Y.O.	1.60	2.87	2.45			
9-10 Y.O.	2.50	4.31	5.43			
14-15 Y.O.	2.70	4.06	4.98			
ADULTES	2.50	4.17	4.37			

Table 4 : Nb. correct different sequences : means and standard deviations, according to experimental group and to age.

MEANS - NB. INCORRECT DIFFERENT SEQUENCES (NIS)						
	N	N	N	N	R	N
5-6 Y.O.	5.73	4.33	3.26	5.11	9.33	5.22
9-10 Y.O.	3.30	2.05	2.10	2.22	9.16	2.16
14-15 Y.O.	2.64	1.82	1.47	1.90	6.40	.95
ADULTES	2.23	2.00	1.61	2.40	5.70	1.05
	N	D	N	D	R	N
5-6 Y.O.	3.25	3.62	3.06	5.15	6.53	3.30
9-10 Y.O.	2.87	2.84	1.62	3.92	9.17	2.41
14-15 Y.O.	1.94	1.63	.47	2.61	3.71	1
ADULTES	2.40	1.40	1.36	2.90	6.40	1.30
	R	D	N			
5-6 Y.O.	5.70	6.29	4.41			
9-10 Y.O.	11.41	5.11	2.17			
14-15 Y.O.	9.47	3.66	2.14			
ADULTES	7.36	2.84	1.26			
STANDARD DEVIATIONS- NB. INCORRECT DIFFERENT SEQUENCES (NIS)						
	N	N	N	N	R	N
5-6 Y.O.	4.00	3.37	2.68	3.90	5.66	4.88
9-10 Y.O.	2.60	3.17	3.83	1.80	4.47	3.66
14-15 Y.O.	2.30	2.15	1.41	2.10	4.86	.94
ADULTES	1.80	1.73	1.62	1.70	4.37	1.50
	N	D	N	D	R	N
5-6 Y.O.	2.20	2.50	3.97	2.70	3.99	2.49
9-10 Y.O.	1.60	1.83	1.33	2.40	4.06	2.32
14-15 Y.O.	1.70	1.38	.84	2.10	3.50	1.37
ADULTES	2.10	1.63	1.26	3.50	3.01	3.09
	R	D	N			
5-6 Y.O.	4.00	4.52	3.04			
9-10 Y.O.	3.80	3.62	1.70			
14-15 Y.O.	3.30	3.36	2.45			
ADULTES	3.90	1.86	1.59			

Table 5 : Nb. incorrect different sequences : means and standard deviations, according to experimental group and to age.

MEANS -				NB. SEQ. DIFF. 2 PREV. (NSD_2)		
	N	N	N	N	R	N
5-6 Y.O.	12.40	9.13	10.20	12.94	12.55	10.77
9-10 Y.O.	16.20	11.93	11.30	16.27	14.16	10.22
14-15 Y.O.	18.30	19.70	20.41	16	11.45	9.55
ADULTES	15.30	14.09	13.23	13.50	14	17.60
	N	D	N	D	R	N
5-6 Y.O.	7.81	16	10.06	17.23	15	12
9-10 Y.O.	13.57	24.94	19.84	31	17.11	27
14-15 Y.O.	20.52	38.42	32.15	35.85	11.33	21.09
ADULTES	15.55	37.95	27.20	35.85	9.95	22.90
	R	D	N			
5-6 Y.O.	14.64	15.64	11.05			
9-10 Y.O.	15.58	25	20.17			
14-15 Y.O.	11.11	29.66	25.70			
ADULTES	9.36	31.15	26.89			
STANDARD DEVIATIONS -				NB. SEQ. DIFF. 2 PREV. (NSD_2)		
	N	N	N	N	R	N
5-6 Y.O.	8.00	5.42	7.62	7.30	6.03	4.96
9-10 Y.O.	10.73	10.51	11.12	10.80	6.11	9.09
14-15 Y.O.	12.20	12.28	12.07	11.30	6.41	8.00
ADULTES	11.60	10.59	11.90	8.60	10.19	15.56
	N	D	N	D	R	N
5-6 Y.O.	6.90	7.06	8.91	7.60	5.78	5.65
9-10 Y.O.	7.70	7.21	14.39	9.90	5.61	12.96
14-15 Y.O.	12.00	5.84	15.51	7.20	9.05	15.15
ADULTES	9.80	7.22	17.02	6.50	7.30	16.03
	R	D	N			
5-6 Y.O.	4.20	5.68	6.09			
9-10 Y.O.	5.90	9.61	14.48			
14-15 Y.O.	6.10	9.08	16.69			
ADULTES	5.00	10.17	16.41			

Table 6 : Nb. sequences different 2 previous ones : means and standard deviations, according to experimental group and to age.

MEANS - SEQUENCES UNCERTAINTY (U(S))						
	N	N	N	N	R	N
5-6 Y.O.	2.14	1.57	1.45	2.14	2.72	1.97
9-10 Y.O.	2.01	1.44	1.40	1.75	2.87	1.25
14-15 Y.O.	2.01	1.81	1.78	1.83	2.10	.96
ADULTES	1.79	1.67	1.53	1.83	2.34	1.66
	N	D	N	D	R	N
5-6 Y.O.	1.35	2.10	1.36	2.69	2.44	1.54
9-10 Y.O.	1.82	2.74	1.90	3.34	3.23	2.68
14-15 Y.O.	2.10	3.45	2.53	3.52	1.66	1.94
ADULTES	2.03	3.38	2.48	3.48	1.96	2.12
	R	D	N			
5-6 Y.O.	2.25	2.54	1.79			
9-10 Y.O.	3.59	3.08	2.16			
14-15 Y.O.	2.81	3.21	2.32			
ADULTES	2.21	2.89	2.12			
STANDARD DEVIATIONS - SEQUENCES UNCERTAINTY (U(S))						
	N	N	N	N	R	N
5-6 Y.O.	1.10	.97	1.11	1.07	1.27	1.14
9-10 Y.O.	1.12	1.09	1.22	.94	1.12	1.24
14-15 Y.O.	1.22	1.08	.96	1.00	1.17	.76
ADULTES	1.16	1.16	1.13	1.04	1.11	1.36
	N	D	N	D	R	N
5-6 Y.O.	.96	.75	1.28	.90	1.03	.77
9-10 Y.O.	.96	.67	1.17	.77	.98	1.03
14-15 Y.O.	1.12	.30	1.28	.53	.88	1.39
ADULTES	1.17	.79	1.49	.53	.84	1.35
	R	D	N			
5-6 Y.O.	.94	.98	1.05			
9-10 Y.O.	.66	.94	1.22			
14-15 Y.O.	.98	.57	1.88			
ADULTES	.98	.70	1.06			

Table 7 : Sequences uncertainty : means and standard deviations, according to experimental group and to age.

MEANS - CORRECT SEQUENCES UNCERTAINTY (U(CS))						
	N	N	N	N	R	N
5-6 Y.O.	1.31	.95	.92	1.36	1.68	1.30
9-10 Y.O.	1.63	1.17	1.18	1.46	1.73	1.02
14-15 Y.O.	1.71	1.61	1.60	1.60	1.31	.82
ADULTES	1.52	1.42	1.23	1.51	1.62	1.54
	N	D	N	D	R	N
5-6 Y.O.	.75	1.55	.92	1.97	1.58	1
9-10 Y.O.	1.37	2.41	1.71	2.94	2.16	2.40
14-15 Y.O.	1.88	3.33	2.49	3.29	1.12	1.84
ADULTES	1.74	3.29	2.35	3.24	1.05	1.93
	R	D	N			
5-6 Y.O.	1.46	1.69	1.05			
9-10 Y.O.	2.27	2.52	1.94			
14-15 Y.O.	1.57	2.76	2.01			
ADULTES	1.20	2.59	1.99			
STANDARD DEVIATIONS- CORRECT SEQUENCES UNCERTAINTY (U(CS))						
	N	N	N	N	R	N
5-6 Y.O.	.97	.66	.83	.83	1.07	.79
9-10 Y.O.	1.06	.99	1.12	.93	.91	1.01
14-15 Y.O.	1.10	1.00	.93	.98	.86	.75
ADULTES	1.09	1.07	1.14	.93	1.01	1.34
	N	D	N	D	R	N
5-6 Y.O.	.78	.70	1.01	.97	.88	.59
9-10 Y.O.	.86	.67	1.15	.80	.82	1.04
14-15 Y.O.	1.10	.32	1.26	.56	.67	1.32
ADULTES	1.05	.76	1.45	.51	.72	1.39
	R	D	N			
5-6 Y.O.	.47	.69	.71			
9-10 Y.O.	.77	.93	1.16			
14-15 Y.O.	.90	.77	1.26			
ADULTES	.73	.74	1.05			

Table 8 : Correct sequences uncertainty : means and standard deviations, according to experimental group and to age.

MEANS - INCORRECT SEQUENCES UNCERTAINTY U(IS)						
	N	N	N	N	R	N
5-6 Y.O.	1.94	1.59	1.24	1.67	2.48	1.59
9-10 Y.O.	1.16	.64	.58	.86	2.79	.63
14-15 Y.O.	1.05	.73	.46	.71	2.12	.25
ADULTES	.88	.78	.53	.96	1.88	.36
	N	D	N	D	R	N
5-6 Y.O.	1.09	1.48	.98	1.93	2.23	1.33
9-10 Y.O.	1.13	1.16	.63	1.78	2.72	.89
14-15 Y.O.	.76	.72	.13	1.04	1.26	.33
ADULTES	.94	.50	.47	.98	2.36	.12
	R	D	N			
5-6 Y.O.	1.93	2.07	1.60			
9-10 Y.O.	3.11	1.93	.98			
14-15 Y.O.	2.81	1.33	.77			
ADULTES	2.47	1.29	.49			
STANDARD DEVIATIONS - INCORRECT SEQUENCES UNCERTAINTY U(IS)						
	N	N	N	N	R	N
5-6 Y.O.	1.07	.94	1.06	1.15	1.29	1.23
9-10 Y.O.	1.03	.95	.96	.95	.79	1.04
14-15 Y.O.	1.03	.92	.72	.94	1.14	.53
ADULTES	.96	.77	.71	.84	1.18	.76
	N	D	N	D	R	N
5-6 Y.O.	.90	.92	1.17	.89	.72	.99
9-10 Y.O.	.74	.94	.75	1.00	.75	.97
14-15 Y.O.	.86	.73	.41	.96	1.25	.67
ADULTES	.94	.84	.69	1.11	.83	.40
	R	D	N			
5-6 Y.O.	1.14	.92	.97			
9-10 Y.O.	.50	.95	.83			
14-15 Y.O.	.55	1.11	.96			
ADULTES	.80	.83	.76			

Table 9 : Incorrect sequences uncertainty : means and standard deviations, according to experimental group and to age.

MEANS - MEAN REALIZATION TIME (MTR)						
	N	N	N	N	R	N
5-6 Y.O.	4.96	3.00	2.21	5.02	5.17	4.05
9-10 Y.O.	3.46	1.59	1.73	3.13	4.06	1.86
14-15 Y.O.	3.48	1.49	1.29	1.98	3.56	1.21
ADULTES	2.34	1.31	1.20	1.69	4.15	.97
	N	D	N	D	R	N
5-6 Y.O.	6.47	4	3.22	6.08	4.30	3.08
9-10 Y.O.	2.98	2.29	1.84	4.11	3.61	2.05
14-15 Y.O.	1.89	1.71	1.13	2.65	3.08	1.15
ADULTES	2.10	2.19	1.22	2.88	3.40	2.92
	R	D	N			
5-6 Y.O.	5.77	4.36	3.55			
9-10 Y.O.	5.44	2.71	2.09			
14-15 Y.O.	3.96	2.05	1.28			
ADULTES	5.61	2.19	1.46			

STANDARD DEVIATIONS - MEAN REALIZATION TIME (MTR)						
	N	N	N	N	R	N
5-6 Y.O.	1.92	1.18	1.12	2.47	2.25	3.47
9-10 Y.O.	1.89	.74	1.64	1.69	1.86	1.13
14-15 Y.O.	3.03	1.12	.71	1.04	1.33	.71
ADULTES	1.76	.76	.65	1.20	2.10	.37
	N	D	N	D	R	N
5-6 Y.O.	3.80	2.07	1.65	2.45	1.21	1.15
9-10 Y.O.	2.03	1.02	1.32	1.25	1.62	1.26
14-15 Y.O.	1.40	.72	.36	1.66	1.09	.50
ADULTES	1.64	1.23	.48	1.75	1.73	4.05
	R	D	N			
5-6 Y.O.	2.69	2.22	1.98			
9-10 Y.O.	2.77	.92	1.02			
14-15 Y.O.	1.71	.87	.71			
ADULTES	3.55	.94	.58			

Table 10 : Mean realization time : means and standard deviations, according to experimental group and to age.

MEANS -				MEAN LATENCY TIME (MTL)		
	N	N	N	N	R	N
5-6 Y.O.	2.26	1.27	1.53	2.27	2.22	2.24
9-10 Y.O.	1.22	.81	.93	1.06	1.16	.92
14-15 Y.O.	1.38	.74	.74	.82	.91	.60
ADULTES	.94	.73	.60	.73	1.03	.62
	N	D	N	D	R	N
5-6 Y.O.	1.99	2.84	1.74	2.58	1.79	1.76
9-10 Y.O.	1.25	.95	.92	1.69	1.25	1.28
14-15 Y.O.	.90	.88	.84	.93	.81	.84
ADULTES	1.02	.97	.75	1.06	1.01	.68
	R	D	N			
5-6 Y.O.	1.87	1.73	1.56			
9-10 Y.O.	1.80	1.06	1.21			
14-15 Y.O.	1.35	.83	.67			
ADULTES	1.73	1.48	.77			
STANDARD DEVIATIONS -				MEAN LATENCY TIME (MTL)		
	N	N	N	N	R	N
5-6 Y.O.	.93	.48	.81	1.35	1.29	1.46
9-10 Y.O.	.40	.18	.36	.48	.66	.43
14-15 Y.O.	1.13	.38	.32	.37	.42	.23
ADULTES	.65	.34	.18	.36	.46	.19
	N	D	N	D	R	N
5-6 Y.O.	1.04	1.88	1.10	1.22	.61	.75
9-10 Y.O.	.91	.55	.61	.62	.57	1.33
14-15 Y.O.	.52	.37	.43	.36	.35	.74
ADULTES	1.16	.41	.41	.49	.31	.28
	R	D	N			
5-6 Y.O.	.84	.68	.35			
9-10 Y.O.	1.14	.66	1.47			
14-15 Y.O.	.96	.58	.38			
ADULTES	1.22	1.50	.31			

Table 11 : Mean latency time : means and standard deviations, according to experimental group and to age.

% CORRECT SEQUENCE (%CS)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	77.06	78.35	76.92	81.73	58.66	86.87
9-10 Y.O.	89.61	51.52	89	94.26	67.55	91.15
14-15 Y.O.	93.92	65.61	92.57	95.29	80.11	96.75
ADULTS	92.55	75.78	91.80	93.33	80.50	96.84

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	87.20	75.55	89.62	88.15	78.82
9-10 Y.O.	92.90	93.77	95.75	92.82	94.58
14-15 Y.O.	96.23	97.40	99.05	97.42	92.87
ADULTS	91.52	97.50	96.10	94.10	97.17

	nR	dR	nD	rD
5-6 Y.O.	58.66	73.69	86.87	71.17
9-10 Y.O.	67.55	61.41	91.15	82.82
14-15 Y.O.	80.11	86.28	96.75	87.52
ADULTS	80.50	82.20	96.84	93.26

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	75.42	79.20	82.22	74	73	80
9-10 Y.O.	91.93	87.21	56	46.50	92.28	86.80
14-15 Y.O.	94.10	93.50	65.80	65.30	94.40	91.10
ADULTS	93.50	91.90	81	72	94	90.60

TABLE 12 : %CS: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

% DOMINANT SEQUENCE (%DS)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	60.48	49.52	36.92	67.46	44.11	49.50
9-10 Y.O.	59.54	27.40	23.80	64.80	45.44	33.36
14-15 Y.O.	53.57	46	20.57	54.58	59.20	20.52
ADULTS	57.70	57.70	20.70	62.47	51.60	21.80

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	67.86	55.88	70.50	68.92	61.52
9-10 Y.O.	66.80	73.77	55.57	38.94	48.82
14-15 Y.O.	54.70	74.80	39.47	53.04	45.52
ADULTS	63.71	61.10	43.20	49.10	44.73

	nR	dR	nD	rD
5-6 Y.O.	44.11	50.46	49.50	40.94
9-10 Y.O.	45.44	36.94	33.36	31.17
14-15 Y.O.	59.20	62.66	20.52	24.47
ADULTS	51.60	61.80	21.80	28.52

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	60.78	60	48.44	50.75	40.33	34
9-10 Y.O.	57.24	61.90	32.22	22	21.42	25.60
14-15 Y.O.	55.42	49.66	51	39.55	20.80	20.30
ADULTS	60.60	55.80	64	53.20	21.10	20.40

TABLE 13 : %DS: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

NB CORRECT DIFFERENT SEQUENCES (NCS)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	4.65	5.40	6.60	3.93	5.72	5.25
9-10 Y.O.	5.90	8.20	11.40	4.20	6.94	8.57
14-15 Y.O.	6.90	6.40	13.30	5.76	5.35	13.63
ADULTS	6.65	5.15	13	6	6.80	13.55

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	3.86	4.50	4.06	4.46	4.52
9-10 Y.O.	4.60	4.83	6.89	9.70	7.76
14-15 Y.O.	5.94	3.25	9.73	7.66	7.70
ADULTS	5.09	6.45	10.15	8	7.05

	nR	dR	nD	rD
5-6 Y.O.	5.72	5.76	5.25	5.82
9-10 Y.O.	6.94	7.70	8.57	9.58
14-15 Y.O.	5.35	4.47	13.63	10.47
ADULTS	6.80	4.60	13.55	8.89

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	4.50	4.80	5.50	5.20	5.60	7.40
9-10 Y.O.	6	5.80	7.50	9	12.80	10.40
14-15 Y.O.	6.50	7.60	5.90	7.20	13.10	13.50
ADULTS	5	7.60	4.20	5.80	13.40	12.80

TABLE 14 : NCS: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

NB INCORRECT DIFFERENT SEQUENCES (NIS)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	4.69	5.70	5.15	4.33	9.33	3.62
9-10 Y.O.	2.80	11.40	4.30	2.05	9.16	2.84
14-15 Y.O.	2.14	9.47	2.61	1.82	6.40	1.63
ADULTS	2.30	7.30	2.90	2	5.70	1.40

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	3.26	5.22	3.06	3.30	4.41
9-10 Y.O.	2.10	2.16	1.62	2.41	2.17
14-15 Y.O.	1.47	.95	.47	1	2.14
ADULTS	1.61	1.05	1.36	1.30	1.26

	nR	dR	nD	rD
5-6 Y.O.	9.33	6.53	3.62	6.29
9-10 Y.O.	9.16	9.17	2.84	5.11
14-15 Y.O.	6.40	3.71	1.63	3.66
ADULTS	5.70	6.40	1.40	2.84

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	4.40	5	5.60	5.70	5.50	4.80
9-10 Y.O.	2.40	3.20	10.30	12.60	3.40	4.90
14-15 Y.O.	1.97	2.50	8.60	10.50	2.30	2.80
ADULTS	1.80	2.60	6.20	8.10	2	3.30

TABLE 15 : NIS: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

NB. SEQUENCES DIFF. 2 PREV. (NSD2)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	11.10	14.64	17.23	9.13	12.55	16
9-10 Y.O.	15.35	15.58	31	11.93	14.16	24.94
14-15 Y.O.	18.25	11.52	35.85	19.70	11.45	38.42
ADULTS	14.81	9.36	35.85	14.09	14	37.95

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	10.20	10.77	10.06	12	11.05
9-10 Y.O.	11.30	10.22	19.84	27	20.17
14-15 Y.O.	20.41	9.55	32.15	21.09	25.70
ADULTS	13.23	17.60	27.20	22.90	26.89

	nR	dR	nD	rD
5-6 Y.O.	12.55	15	16	15.64
9-10 Y.O.	14.16	17.11	24.94	25
14-15 Y.O.	11.45	11.33	38.42	29.66
ADULTS	14	9.95	37.95	31.15

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	10.89	11.38	16.77	12.25	14.33	19.71
9-10 Y.O.	16.79	13.85	15.33	15.87	31.28	30.90
14-15 Y.O.	16.63	21.66	10.25	13.22	36.11	35.66
ADULTS	13.16	15.89	8.37	10.09	36.57.	35.46

TABLE 16 : NSD2: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

SEQUENCES UNCERTAINTY (U(S))

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	1.80	2.20	2.60	1.57	2.72	2.10
9-10 Y.O.	1.86	3.59	3.34	1.44	2.87	2.74
14-15 Y.O.	1.97	2.81	3.52	1.81	2.10	3.45
ADULTS	1.89	2.21	3.48	1.67	2.34	3.38

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	1.45	1.97	1.36	1.54	1.79
9-10 Y.O.	1.40	1.25	1.90	2.68	2.16
14-15 Y.O.	1.78	.96	2.53	1.94	2.32
ADULTS	1.53	1.66	2.48	2.12	2.12

	nR	dR	nD	rD
5-6 Y.O.	2.72	2.44	2.10	2.54
9-10 Y.O.	2.87	3.23	2.74	3.08
14-15 Y.O.	2.10	1.66	3.45	3.21
ADULTS	2.34	1.96	3.38	2.89

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	1.80	1.90	2.30	2.20	2.50	2.80
9-10 Y.O.	1.89	1.84	3.32	3.88	3.40	3.25
14-15 Y.O.	1.86	2.22	2.58	3.12	3.43	3.58
ADULTS	1.58	2.08	1.90	2.40	3.47	3.48

TABLE 17 : U(S): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

CORRECT SEQUENCES UNCERTAINTY (U(cs))

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	1.15	1.46	1.97	.95	1.68	1.55
9-10 Y.O.	1.49	2.27	2.94	1.17	1.73	2.41
14-15 Y.O.	1.73	1.57	3.29	1.61	1.31	3.33
ADULTS	1.59	1.20	3.24	1.42	1.62	3.29

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	.92	1.30	.92	1	1.05
9-10 Y.O.	1.18	1.02	1.71	2.40	1.94
14-15 Y.O.	1.60	.82	2.49	1.84	2.01
ADULTS	1.23	1.54	2.35	1.93	1.99

	nR	dR	nD	rD
5-6 Y.O.	1.68	1.58	1.55	1.69
9-10 Y.O.	1.73	2.16	2.41	2.52
14-15 Y.O.	1.31	1.12	3.33	2.76
ADULTS	1.62	1.05	3.29	2.59

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	1.13	1.17	1.52	1.39	1.59	2.29
9-10 Y.O.	1.54	1.44	2.12	2.43	3.20	2.77
14-15 Y.O.	1.62	1.94	1.39	1.81	3.25	3.32
ADULTS	1.34	1.76	.95	1.38	3.29	3.21

TABLE 18 : U(CS): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

INCORRECT SEQUENCES UNCERTAINTY (U(IS))

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	1.56	1.93	1.93	1.59	2.48	1.48
9-10 Y.O.	1.06	3.11	1.78	.64	2.79	1.16
14-15 Y.O.	.83	2.84	1.04	.73	2.12	.72
ADULTS	.93	2.47	.98	.78	1.88	.50

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	1.24	1.59	.98	1.33	1.60
9-10 Y.O.	.58	.63	.63	.89	.98
14-15 Y.O.	.46	.25	.13	.33	.77
ADULTS	.53	.36	.47	.12	.49

	nR	dR	nD	rD
5-6 Y.O.	2.48	2.23	1.48	2.07
9-10 Y.O.	2.79	2.72	1.16	1.93
14-15 Y.O.	2.12	1.26	.72	1.33
ADULTS	1.88	2.36	.50	1.29

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	1.48	1.67	2.07	1.78	2.08	1.79
9-10 Y.O.	.89	1.23	2.95	3.29	1.53	1.96
14-15 Y.O.	.76	.96	2.63	3.12	.90	1.15
ADULTS	.65	1.11	2.22	2.66	.67	1.15

TABLE 19 : U(IS): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

MEAN REALIZATION TIME (MTR)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	5.47	5.77	6.08	3	5.17	4
9-10 Y.O.	3.20	5.44	4.11	1.59	4.06	2.29
14-15 Y.O.	2.40	3.90	2.62	1.49	3.56	1.71
ADULTS	2.05	5.65	2.80	1.31	4.15	2.19

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	2.21	4.05	3.22	3.08	3.55
9-10 Y.O.	1.73	1.86	1.84	2.05	2.09
14-15 Y.O.	1.29	1.21	1.13	1.15	1.28
ADULTS	1.20	.97	1.22	2.92	1.46

	nR	dR	nD	rD
5-6 Y.O.	5.17	4.30	4	4.36
9-10 Y.O.	4.06	3.61	2.29	2.71
14-15 Y.O.	3.56	3.08	1.71	2.05
ADULTS	4.15	3.40	2.19	2.19

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	5.55	5.37	6.12	5.38	7.03	5.26
9-10 Y.O.	3.30	3	5.74	5.10	4.65	3.74
14-15 Y.O.	2.57	2.04	4.41	3.36	3.52	1.94
ADULTS	1.88	2.16	5.09	6.03	2.59	2.91

TABLE 20 : MTR): - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

MEAN LATENCY TIME (MTL)

	GNxx	Rxx	Dxx	nN	nR	nD
5-6 Y.O.	2.18	1.87	2.58	1.27	2.22	2.84
9-10 Y.O.	1.18	1.80	1.69	.81	1.16	.95
14-15 Y.O.	1.02	1.26	.93	.74	.91	.88
ADULTS	.90	1.73	1.06	.73	1.03	.97

	nnN	nrN	ndN	drN	rdN
5-6 Y.O.	1.53	2.24	1.74	1.76	1.56
9-10 Y.O.	.93	.92	.92	1.28	1.21
14-15 Y.O.	.74	.60	.84	.84	.67
ADULTS	.60	.62	.75	.68	.77

	nR	dR	nD	rD
5-6 Y.O.	2.22	1.79	2.84	1.73
9-10 Y.O.	1.16	1.25	.95	1.06
14-15 Y.O.	.91	.81	.88	.83
ADULTS	1.03	1.01	.97	1.48

	F-GNxx	M-GNxx	F-Rxx	M-Rxx	F-Dxx	M-Dxx
5-6 Y.O.	2.50	1.74	1.71	2.05	2.35	2.78
9-10 Y.O.	1.19	1.18	1.54	2.09	1.58	1.76
14-15 Y.O.	1.11	.83	1.39	1.10	1.11	.79
ADULTS	.70	1.03	1.30	2	1.09	1.04

TABLE 21 : MTL: - means according to age and to presentation order of matrix type.
_ means according to age and to sex, in the first session (F=females; M=males).

CONDITIONAL UNCERTAINTY OF RESPONSES (U(R/s)

	R1	R2	R3	R4	R5	R6
			GN			
5-6 Y.O.	.54	.37	.32	.36	.19	.10
9-10 Y.O.	.65	.38	.38	.24	.13	.05
14-15 Y.O.	.72	.42	.39	.25	.12	.03
ADULTS	.65	.46	.36	.24	.10	.04
			R			
5-6 Y.O.	.79	.38	.38	.25	.23	.21
9-10 Y.O.	.84	.70	.59	.56	.54	.42
14-15 Y.O.	.65	.61	.54	.42	.37	.23
ADULTS	.62	.44	.41	.35	.22	.16
			D			
5-6 Y.O.	.80	.52	.40	.49	.29	.20
9-10 Y.O.	.89	.77	.78	.44	.32	.11
14-15 Y.O.	.92	.88	.75	.49	.37	.07
ADULTS	.93	.89	.81	.46	.29	.06

TABLE 22 : Means of U(R1) and U(R/s) according to age and to matrix type, in the first session.

% CORRECT SEQUENCES (%CS)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 11.29	p<.0000
	FACTOR MATRIX	F(2,352)= 62.85	p<.0000
	AGE X MATRIX	F(6,352)= 9.52	p<.0000
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=9.69	p<.0000
	FACTOR MATRIX	F(2,207)=37.22	p<.0000
	AGE X MATRIX	F(6,207)=9.62	p<.0000

% DOMINANT SEQUENCE (%DS)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 2.48	p<.06
	FACTOR MATRIX	F(2,352)= 66.16	p<.0000
	AGE X MATRIX	F(6,352)= 3.49	p<.002
PRE-TRAINED SUBJECTS	FACTOR AGE	NS	
	FACTOR MATRIX	F(2,207)= 41.33	p<.0000
	AGE X MATRIX	F(6,207)= 4.29	p<.0000

NB CORRECT DIFFERENT SEQUENCES (NCS)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 9.3	p<.0000
	FACTOR MATRIX	F(2,352)= 61.13	p<.0000
	AGE X MATRIX	F(6,352)= 3.90	p<.002
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=12.85	p<.0000
	FACTOR MATRIX	F(2,207)= 53.06	p<.0000
	AGE X MATRIX	F(6,207)= 7.75	p<.0000

NB.INCORRECT DIFFERENT SEQUENCES (N S)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 6.09	p<.0000
	FACTOR MATRIX	F(2,352)=110.13	p<.0000
	AGE X MATRIX	F(6,352)=9.5	p<.0000
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=8.10	p<.0000
	FACTOR MATRIX	F(2,207)=58.94	p<.0000
	AGE X MATRIX	F(6,207)=	NS

NB SEQUENCES DIFFERENT 2 PREVIOUS (NSD2)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 8.55	p<.0000
	FACTOR MATRIX	F(2,352)=101.4	p<.0000
	AGE X MATRIX	F(6,352)=6.37	p<.0000
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=17.27	p<.0000
	FACTOR MATRIX	F(2,207)=98.58	p<.0000
	AGE X MATRIX	F(6,207)=9.15	p<.0000

TABLE 23 : %CS, %DS, NCS, NIS, NSD2: ANOVA (age x matrix) in the first and in the second sessions (after N).

SEQUENCES UNCERTAINTY (U(S)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 2.50	p<.059
	FACTOR MATRIX	F(2,352)= 61.03	p<.0000
	AGE X MATRIX	F(6,352)=3.65	p<.002
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=	NS
	FACTOR MATRIX	F(2,207)=34.04	p<.0000
	AGE X MATRIX	F(6,207)=4.59	p<.0000

CORRECT SEQUENCES UNCERTAINTY (U(CS))

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 7.16	p<.0000
	FACTOR MATRIX	F(2,352)= 69.14	p<.0000
	AGE X MATRIX	F(6,352)= 3.84	p<.001
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)= 6.57	p<.0000
	FACTOR MATRIX	F(2,207)= 53.61	p<.0000
	AGE X MATRIX	F(6,207)= 6.52	p<.0000

INCORRECT SEQUENCES UNCERTAINTY (U(IS))

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 4.95	p<.002
	FACTOR MATRIX	F(2,352)= 73.74	p<.0000
	AGE X MATRIX	F(6,352)= 5.41	p<.0000
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=7.34	p<.0000
	FACTOR MATRIX	F(2,207)= 50.08	p<.0000
	AGE X MATRIX	F(6,207)=	NS

MEAN REALIZATION TIME (MTR)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)= 29.41	p<.0000
	FACTOR MATRIX	F(2,352)=23.45	p<.0000
	AGE X MATRIX	F(6,352)=2.8	p<.01
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=14.94	p<.0000
	FACTOR MATRIX	F(2,207)=51.89	p<.0000
	AGE X MATRIX	F(6,207)=	NS

MEAN LATENCY TIME (MTL)

ANOVA (AGE X MATRIX)			
NAIVE SUBJECTS	FACTOR AGE	F(3,352)=30.16	p<.0000
	FACTOR MATRIX	F(2,352)=5.58	p<.004
	AGE X MATRIX	F(6,352)=3.11	p<.006
PRE-TRAINED SUBJECTS	FACTOR AGE	F(3,207)=34.33	p<.0000
	FACTOR MATRIX	F(2,207)=9.09	p<.0000
	AGE X MATRIX	F(6,207)=3.6	p<.002

TABLE 24 : U(S), U(CS), U(IS), MTR, MTL: ANOVA (age x matrix) in the first and in the second sessions (after N).

% CORRECT SEQUENCES (%CS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=.02 NS	X2=36.49 p<.0000	X2=41.37 p<.0000	X2=22.73 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1 *	1 *	1
2= R	2	2	2	2
3= D	3	3 *	3 *	3 *

% DOMINANT SEQUENCE (%DS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=6.1 p<0.003	X2=41.46 p<.0000	X2=31.68 p<.0000	X2=34.79 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1	1 *
2= R	2	2 *	2	2
3= D	3 *	3 *	3 * *	3

NB. CORRECT DIFFERENT SEQUENCES (NCS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=2.2 NS	X2=21.50 p<.0000	X2=28.11 p<.0000	X2=29.33 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1 *	1	1
2= R	2	2	2	2
3= D	3	3 * *	3 * *	3 * *

NB. INCORRECT DIFFERENT SEQUENCES (NIS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=.4 NS	X2=39.48 p<0.0000	X2=42.24 p<0.0000	X2=26.66 p<0.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1 *	1 *
2= R	2	2 *	2	2
3= D	3	3 * *	3 *	3 *

NB SEQUENCES DIFFERENT 2 PREVIOUS (NSD2)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=3.9 p>.02	X2=22.89 p<0.0000	X2=36.89 p<.0000	X2=43.7 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1	1
2= R	2	2	2 *	2
3= D	3 *	3 * *	3 * *	3 * *

TABLE 25 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (matrix) and Newman-Keuls test among the 5-6 Y.O., in the first session. - Kruskal-Wallis (matrix) and Mann-Wihtney tests among 9-10 Y.O., 14-15 Y.O., ADULTS, in the first session.
(*) indicates a significant difference with P<.05.

SEQUENCES UNCERTAINTY (U(S))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=3.2 p<.04	X2=40.44 p<.0000	X2=30.8 p<.0000	X2=28.77 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1	1
2= R	2	2 *	2 *	2
3= D	3 *	3 *	3 * *	3 * *

CORRECT SEQUENCES UNCERTAINTY (U(CS))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=4.5 p<0.01	X2=26.73 p<.0000	X2=32.67 p<.0000	X2=36.17 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1	1
2= R	2	2 *	2	2
3= D	3 *	3 * *	3 * *	3 * *

INCORRECT SEQUENCES UNCERTAINTY (U(IS))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=.98 NS	X2=40.7 p<.0000	X2=39.94 p<.0000	X2=27.81 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1	1
2= R	2	2 *	2 * *	2 * *
3= D	3	3 * *	3	3

MEAN REALIZATION TIME (MTR)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=.37 NS	X2=18.30 p<0.0001	X2=17.19 p<0.0002	X2=30.14 p<0.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1 *	1
2= R	2	2 *	2	2 *
3= D	3	3 *	3 *	3 * *

MEAN LATENCY TIME (MTL)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,74)=1.5 NS	X2=12.44 p<0.002	X2= NS	X2=20.03 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= GN	1	1	1	1
2= R	2	2 *	2	2 *
3= D	3	3 *	3	3 *

TABLE 26 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (matrix) and Newman-Keuls test among the 5-6 Y.O., in the first session.

- Kruskal-Wallis (matrix) and Mann-Wihtney tests among 9-10 Y.O., 14-15 Y.O., ADULTS, in the first session.
(*) indicates a significant difference with P<.05.

SUJETS PREENTRAINES

% CORRECT SEQUENCES (%CS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=6.8 p<.003	F(2,54)=13. p<.0000	F(2,53)=10. p<.0001	F(2,59)=9.2 p<.0003
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1 *	1 *	1 *	1 *
2= R	2	2	2	2
3= D	3 *	3 *	3 *	3 *

% DOMINANT SEQUENCE (%DS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=6.5 p<0.003	F(2,54)=9.8 p<.0002	F(2,53)=19. p<.0000	F(2,59)=18. p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1	1	1	1
2= R	2 *	2 *	2 *	2 *
3= D	3 *	3 *	3 *	3 *

NB. CORRECT DIFFERENT SEQUENCES (NCS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)= NS	F(2,54)=9.7 p<.0002	F(2,53)=49. p<.0000	F(2,59)=18. p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1	1	1	1
2= R	2	2 *	2	2
3= D	3	3 *	3 * *	3 * *

NB. INCORRECT DIFFERENT SEQUENCES (NIS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=9.9 p<.0003	F(2,54)=25. p<0.0000	F(2,53)=13. p<0.0000	F(2,59)=13. p<0.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1 *	1 *	1 *	1 *
2= R	2	2	2	2
3= D	3 *	3 *	3 *	3 *

NB SEQUENCES DIFFERENT 2 PREVIOUS (NSD2)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=5.2 p>.0009	F(2,54)=13. p<0.0000	F(2,53)=51. p<.0000	F(2,59)=42. p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1	1	1	1
2= R	2	2	2	2
3= D	3 * *	3 * *	3 * *	3 * *

TABLE 27 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (matrix) and Newman-Keuls test for each age group, in the second session. (*) indicates a significant difference with P<.05.

SEQUENCES UNCERTAINTY (U(S))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=5.9 p<.0005	F(2,54)=12. p<.0000	F(2,53)=15. p<.0000	F(2,59)=13. p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1 *	1	1	1
2= R	2	2 *	2	2 *
3= D	3 *	3 *	3 * *	3 * *

CORRECT SEQUENCES UNCERTAINTY (U(CS))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=5.1 p<0.01	F(2,54)=9.8 p<.0002	F(2,53)=37. p<.0000	F(2,59)=22. p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1	1	1	1
2= R	2 *	2	2	2
3= D	3 *	3 * *	3 * *	3 * *

INCORRECT SEQUENCES UNCERTAINTY (U(IS))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=4.1 p<.02	F(2,54)=28. p<.0000	F(2,53)=13. p<.0000	F(2,59)=11. p<.0001
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1 *	1 *	1 *	1 *
2= R	2	2	2	2
3= D	3 *	3 *	3 *	3 *

MEAN REALIZATION TIME (MTR)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=4.6 p<.01	F(2,54)=18. p<0.0000	F(2,53)=20. p<0.0000	F(2,59)=18. p<0.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1	1 *	1 *	1 *
2= R	2 *	2	2	2
3= D	3	3 *	3 *	3 *

MEAN LATENCY TIME (MTL)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	F(2,42)=4.9 P<.01	F(2,54)= NS	F(2,53)= NS	F(2,59)=3.2 p<.0000
	1 2 3	1 2 3	1 2 3	1 2 3
1= N	1	1	1	1
2= R	2 *	2	2	2
3= D	3 *	3	3	3

TABLE 28 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (matrix) and Newman-Keuls test for each age group, in the second session.
(*) indicates a significant difference with P<.05.

% CORRECT SEQUENCES (%CS)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)= 15.4	p<.0000
FACTOR PRE-T.	F(4,344)=	NS
AGE X PRE-T	F(12,344)=	NS

% DOMINANT SEQUENCE (%DS)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)= 3.76	p<.01
FACTOR PRE-T.	F(4,344)= 6.43	p<.0000
AGE X PRE-T	F(12,344)= 1.94	p<.03

NB CORRECT DIFFERENT SEQUENCES (NCS)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=7.57	p<.0000
FACTOR PRE-T.	F(4,344)=8.1	p<.0000
AGE X PRE-T	F(12,344)= 1.82	p<.04

NB.INCORRECT DIFFERENT SEQUENCES (NIS)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)= 18.98	p<.0000
FACTOR PRE-T.	F(4,344)=	NS
AGE X PRE-T	F(12,344)=	NS

NB SEQUENCES DIFFERENT 2 PREVIOUS (NSD2)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=12.91	p<.0000
FACTOR PRE-T.	F(4,344)=10.68	p<.0000
AGE X PRE-T	F(12,344)=2.37	p<.006

TABLE 29 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (age x pre-training)in the third session.

SEQUENCES UNCERTAINTY (U(S)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=	NS
FACTOR PRE-T.	F(4,344)=6.26	p<.0000
AGE X PRE-T	F(12,344)=1.93	p<.03

CORRECT SEQUENCES UNCERTAINTY (U(CS))

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=8.37	p<.0000
FACTOR PRE-T.	F(4,344)=7.50	p<.0000
AGE X PRE-T	F(12,344)=2.12	p<.01

INCORRECT SEQUENCES UNCERTAINTY (U(IS))

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=22.31	p<.0000
FACTOR PRE-T.	F(4,344)=	NS
AGE X PRE-T	F(12,344)=	NS

MEAN REALIZATION TIME (MTR)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=29.64	p<.0000
FACTOR PRE-T.	F(4,344)=2.71	p<.03
AGE X PRE-T	F(12,344)=2.05	p<.02

MEAN LATENCY TIME (MTL)

ANOVA (AGE X PRE-TRAINING)		
FACTOR AGE	F(3,344)=40.23	p<.0000
FACTOR PRE-T.	F(4,344)=	NS
AGE X PRE-T	F(12,344)=	NS

TABLE 30 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (age x pre-training) in the third session.

% CORRECT SEQUENCES (%CS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	NS	F(4,93)=3.1 p<.02	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2	2
3= NDN	3	3	3	3
4= DRN	4	4	4	4
5= RDN	5	5	5 * *	5

% DOMINANT SEQUENCE (%DS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	F(4,86)=4.9 p<.001	F(4,93)=4.6 p<.002	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1 *	1	1
2= NRN	2	2 * *	2* * * *	2
3= NDN	3	3	3	3
4= DRN	4	4	4	4
5= RDN	5	5	5	5

NB. CORRECT DIFFERENT SEQUENCES (NCS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	F(4,86)=4.0 p<.005	F(4,93)=5.8 p<.0003	F(4,95)=2.5 p<.05
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2 * * *	2
3= NDN	3	3	3	3*
4= DRN	4	4* *	4	4
5= RDN	5	5	5	5

NB.INCORRECT DIFFERENT SEQUENCES (NIS)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	NS	F(4,93)=3.3 p<.01	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2	2
3= NDN	3	3	3	3
4= DRN	4	4	4	4
5= RDN	5	5	5 * *	5

NB SEQUENCES DIFFERENT 2 PREVIOUS (NSD2)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	F(4,86)=5.5 p<.0005	F(4,93)=6.9 p<.0001	F(4,95)=3.1 p<.02
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1 * *
2= NRN	2	2	2* * * *	2
3= NDN	3	3*	3	3
4= DRN	4	4* *	4 *	4
5= RDN	5	5	5	5

TABLE 31 : %CS, %DS, NCS, NIS, NSD2: - ANOVA (pre-training) and Newman-Keuls test for each age group, in the third session.
(*) indicates a significant difference with P<.05.

SEQUENCES UNCERTAINTY (U(S))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	F(4,86)=4.2 p<.004	F(4,93)=5.4 p<.0005	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2* * * *	2
3= NDN	3	3	3	3
4= DRN	4	4* *	4	4
5= RDN	5	5	5	5

CORRECT SEQUENCES UNCERTAINTY (U(CS))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	F(4,86)=4.7 p<.002	F(4,93)=5.7 p<.0004	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2* * * *	2
3= NDN	3	3	3	3
4= DRN	4	4* *	4	4
5= RDN	5	5	5	5

INCORRECT SEQUENCES UNCERTAINTY (U(IS))

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	NS	F(4,93)=2.5 p<.04	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2	2
3= NDN	3	3	3	3
4= DRN	4	4	4	4
5= RDN	5	5	5 *	5

MEAN REALIZATION TIME (MTR)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	NS	NS	F(4,95)=3.5 p<.01
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2	2
3= NDN	3	3	3	3
4= DRN	4	4	4	4* * * *
5= RDN	5	5	5	5

MEAN LATENCY TIME (MTL)

AGE	5-6 Y.O.	9-10 Y.O.	14-15 Y.O.	ADULTS
	NS	NS	NS	NS
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
1= NNN	1	1	1	1
2= NRN	2	2	2	2
3= NDN	3	3	3	3
4= DRN	4	4	4	4
5= RDN	5	5	5	5

TABLE 32 : U(S), U(CS), U(IS), MTR, MTL: - ANOVA (pre-training) and Newman-Keuls test for each age group in the third session.
(*) indicates a significant difference with P<.05.

% CORRECT SEQUENCES (%CS)

SESSIONS	N	N	N
	F.(3,69)=5.48 p<0.0019	F.(3,69)=2.27 NS	F.(3,69)=.93 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2
3= 14-15 Y.O.	3 *	3	3
4= ADULTS	4 *	4	4

SESSIONS	N	R	N
	F.(3,68)=6.97 p<0.0004	F.(3,68)=3.90 p<0.0123	F.(3,68)=5.92 p<0.0012
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	N	D	N
	F.(3,70)=4.53 p<0.0058	F.(3,70)=11.5 p<.0000	F.(3,70)=4.91 p<.0037
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	D	R	N
	F.(3,67)=5.08 p<0.0031	F.(3,67)=7.44 p<0.0002	F.(3,67)=1.48 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4

SESSIONS	R	D	N
	F.(3,70)=7.96 p<0.0001	F.(3,70)=6.42 p<0.0007	F.(3,70)=9.6 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=15.62 p<.0000	F.(3,70)=7.96 p<.0001	F.(3,70)=5.09 p<.003
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

TABLE 33 : %CS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

% DOMINANT SEQUENCE (%DS)

SESSIONS	N	N	N
	F.(3,69)=.35 NS	F.(3,69)=.76 NS	F.(3,69)=.81 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	N	R	N
	F.(3,68)=.24 NS	F.(3,68)=1.81 NS	F.(3,68)=1.87 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 * *	3	3 * *
4= ADULTS	4 * *	4	4 * *

SESSIONS	N	D	N
	F.(3,70)=1.84 NS	F.(3,70)=22 p<.0000	F.(3,70)=3.74 p<.014
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 * *	3 *
4= ADULTS	4 *	4 * *	4 *

SESSIONS	D	R	N
	F.(3,67)=7.42 p<0.0002	F.(3,67)=6.16 p<0.009	F.(3,67)=3.26 p<.026
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 * *
4= ADULTS	4 *	4 *	4 *

SESSIONS	R	D	N
	F.(3,70)=8 p<0.0001	F.(3,70)=4.39 p<0.0069	F.(3,70)=1.52 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=1.67 NS	F.(3,70)=8.003 p<.0001	F.(3,70)=7.42 p<.0002
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2	2	2 *
3= 14-15 Y.O.	3	3 *	3 *
4= ADULTS	4	4 *	4 *

TABLE 34 : %DS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

NB. CORRECT DIFFERENT SEQUENCES (NCS)

SESSIONS	N	N	N
	F.(3,69)=.40 NS	F.(3,69)=1.56 NS	F.(3,69)=1.01 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3	3
4= ADULTS	4	4	4

SESSIONS	N	R	N
	F.(3,68)=.12 NS	F.(3,68)=.97 NS	F.(3,68)=2.31 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3	3
4= ADULTS	4	4	4

SESSIONS	N	D	N
	F.(3,70)=5.36 p<.0022	F.(3,70)=25.99 p<.0000	F.(3,70)=5.58 p<.0017
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3 *	3 * *	3 *
4= ADULTS	4 *	4 * *	4 *

SESSIONS	D	R	N
	F.(3,67)=9.28 p<0.0000	F.(3,67)=6.38 p<0.0007	F.(3,67)=2.52 p<.065
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4

SESSIONS	R	D	N
	F.(3,70)=5.82 p<0.0013	F.(3,70)=4.77 p<0.0044	F.(3,70)=2.02 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4

SESSIONS	GN	R	D
	F.(3,215)=3.23 p<.02	F.(3,70)=5.82 p<.001	F.(3,70)=9.29 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2	2	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

TABLE 35 : NCS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

NB. INCORRECT DIFFERENT SEQUENCES (NIS)

SESSIONS	N	N	N
	F.(3,69)=5.36 p<.0022	F.(3,69)=3.19 p<.028	F.(3,69)=1.57 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4

SESSIONS	N	R	N
	F.(3,68)=6.66 p<.0005	F.(3,68)=3.07 p<.033	F.(3,68)=6.22 p<.0008
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4 *	4	4 *

SESSIONS	N	D	N
	F.(3,70)=1.52 NS	F.(3,70)=5.68 p<.0015	F.(3,70)=4.45 p<.0063
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3 *	3 * *	3 *
4= ADULTS	4 *	4 * *	4 *

SESSIONS	D	R	N
	F.(3,67)=2.97 p<0.037	F.(3,67)=7.19 p<0.0003	F.(3,67)=3.17 p<.0296
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4 *	4 *	4

SESSIONS	R	D	N
	F.(3,70)=7.49 p<0.0002	F.(3,70)=3.58 p<0.017	F.(3,70)=6.17 p<.0009
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=11.69 p<.0000	F.(3,70)=7.49 p<0.0002	F.(3,70)=2.97 p<.037
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2	2
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4

TABLE 36 : NIS : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

NB. SEQ. DIFF. 2 PREV. (NSD2)

SESSIONS	N	N	N
	F.(3,69)=.81 NS	F.(3,69)=3.19 p<.028	F.(3,69)=2.95 p<.038
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4

SESSIONS	N	R	N
	F.(3,68)=.35 NS	F.(3,68)=.55 NS	F.(3,68)=2.43 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4 *	4	4 *

SESSIONS	N	D	N
	F.(3,70)=5.39 p<.0021	F.(3,70)=44.16 p<.0000	F.(3,70)=7.60 p<.0002
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3 *	3 * *	3 * *
4= ADULTS	4 *	4 * *	4 *

SESSIONS	D	R	N
	F.(3,67)=18.37 p<0.0000	F.(3,67)=3.66 p<0.016	F.(3,67)=3.07 p<.033
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4

SESSIONS	R	D	N
	F.(3,70)=5.04 p<0.0032	F.(3,70)=11.09 p<.0000	F.(3,70)=4.57 p<.0056
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=4.04 p<.008	F.(3,70)=5.04 p<0.0032	F.(3,70)=18.37 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2 *
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4	4 * *	4 *

TABLE 37 : NSD2 : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

SESSIONS	N	N	N
	F.(3,69)=.28 NS	F.(3,69)=.37 NS	F.(3,69)=.38 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3	3
4= ADULTS	4	4	4

SESSIONS	N	R	N
	F.(3,68)=.63 NS	F.(3,68)=1.99 NS	F.(3,68)=2.35 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3	3
4= ADULTS	4	4	4

SESSIONS	N	D	N
	F.(3,70)=1.71 NS	F.(3,70)=15.78 p<.0000	F.(3,70)=3.03 p<.034
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3	3 * *	3
4= ADULTS	4	4 * *	4 *

SESSIONS	D	R	N
	F.(3,67)=4.69 p<0.0048	F.(3,67)=9.99 p<0.0000	F.(3,67)=2.33 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2	2
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4

SESSIONS	R	D	N
	F.(3,70)=8.62 p<0.0001	F.(3,70)=2.33 NS	F.(3,70)=.70 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3 *	3	3
4= ADULTS	4 *	4	4

SESSIONS	GN	R	D
	F.(3,215)= NS	F.(3,70)=8.62 p<0.0001	F.(3,70)=4.69 p<.0049
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2	2	2 *
3= 14-15 Y.O.	3	3 *	3 *
4= ADULTS	4	4 *	4 *

TABLE 38 : U(S) : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session

CORRECT SEQUENCES UNCERTAINTY (U(CS))

SESSIONS	N	N	N
	F.(3,69)=.41 NS	F.(3,69)=1.45 NS	F.(3,69)=1.21 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3	3
4= ADULTS	4	4	4

SESSIONS	N	R	N
	F.(3,68)=.08 NS	F.(3,68)=1.36 NS	F.(3,68)=1.88 NS
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3	3
4= ADULTS	4	4	4

SESSIONS	N	D	N
	F.(3,70)=4.57 p<.0055	F.(3,70)=29.63 p<.0000	F.(3,70)=5.77 p<.034
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3 *	3 * *	3 *
4= ADULTS	4 *	4 * *	4 *

SESSIONS	D	R	N
	F.(3,67)=11.12 p<0.0000	F.(3,67)=8.05 p<0.0001	F.(3,67)=3.54 p<.019
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4

SESSIONS	R	D	N
	F.(3,70)=6.47 p<0.0006	F.(3,70)=6.5 p<.0006	F.(3,70)=3.26 p<.023
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=2.88 p<.037	F.(3,70)=6.42 p<0.0006	F.(3,70)=11.12 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2	2	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4	4 *	4 *

TABLE 39 : U(CS) : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

SESSIONS	N	N	N
	F.(3,69)=3.39 p<.022	F.(3,69)=3.8 p<.013	F.(3,69)=2.73 p<.05
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3
4= ADULTS	4 *	4 *	4 *

SESSIONS	N	R	N
	F.(3,68)=3.26 p<.026	F.(3,68)=2.42 NS	F.(3,68)=6.36 p<.0007
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4 *	4	4 *

SESSIONS	N	D	N
	F.(3,70)=.74 NS	F.(3,70)=4.65 p<.0051	F.(3,70)=3.47 p<.020
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2	2	2
3= 14-15 Y.O.	3	3 *	3 *
4= ADULTS	4	4 *	4

SESSIONS	D	R	N
	F.(3,67)=3.99 p<0.0112	F.(3,67)=8.60 p<0.0001	F.(3,67)=8.12 p<.0001
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2	2 *	2
3= 14-15 Y.O.	3 * *	3	3 * *
4= ADULTS	4 * *	4 *	4 * *

SESSIONS	R	D	N
	F.(3,70)=7.37 p<0.0002	F.(3,70)=3.14 p<.0303	F.(3,70)=4.98 p<.0034
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3	3 *
4= ADULTS	4 * *	4	4 *

SESSIONS	GN	R	D
	F.(3,215)=5.73 p<.0009	F.(3,70)=7.38 p<0.0002	F.(3,70)=3.99 p<.01
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2
3= 14-15 Y.O.	3 *	3 *	3 * *
4= ADULTS	4 *	4 * *	4 * *

TABLE 40 : U(IS) : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

MEAN REALIZATION TIME

SESSIONS	N	N	N
	F.(3,69)=4.18 p<.0088	F.(3,69)=10.78 p<.0000	F.(3,69)=2.88 p<.042
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	N	R	N
	F.(3,68)=14.52 p<.0000	F.(3,68)=2.04 NS	F.(3,68)=27.55 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 * *	3	3 * *
4= ADULTS	4 * *	4	4 * *

SESSIONS	N	D	N
	F.(3,70)=14.09 p<.0000	F.(3,70)=9.39 p<.0000	F.(3,70)=13.86 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	D	R	N
	F.(3,67)=12.36 p<0.0000	F.(3,67)=1.96 NS	F.(3,67)=2.74 p<.0497
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 * *	3 *	3 * *
4= ADULTS	4 * *	4 *	4 *

SESSIONS	R	D	N
	F.(3,70)=1.87 NS	F.(3,70)=11.26 p<.0000	F.(3,70)=13.80 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 * *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=26.17 p<.0000	F.(3,70)= NS	F.(3,70)=12.37 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 * *	3	3 * *
4= ADULTS	4 * *	4	4 * *

TABLE 41 : MTR : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.

MEAN LATENCY TIME (MTL)

SESSIONS	N	N	N
	F.(3,69)=8.34 p<.0001	F.(3,69)=8.44 p<.0001	F.(3,69)=13.42 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	N	R	N
	F.(3,68)=14.86 p<.0000	F.(3,68)=11.5 NS	F.(3,68)=17.34 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	N	D	N
	F.(3,70)=4.55 p<.0056	F.(3,70)=16.18 p<.0000	F.(3,70)=7.73 p<.0002
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 *	4 *	4 *

SESSIONS	D	R	N
	F.(3,67)=18.62 p<0.0000	F.(3,67)=13.14 p<0.0000	F.(3,67)=5.15 p<.0029
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1 *	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 * *	3 * *	3 *
4= ADULTS	4 * *	4 * *	4 *

SESSIONS	R	D	N
	F.(3,70)=1.32 NS	F.(3,70)=3.52 p<.0193	F.(3,70)=5.19 p<.0027
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1 *	1	1
2= 9-10 Y.O.	2 *	2 *	2 *
3= 14-15 Y.O.	3 *	3 *	3 *
4= ADULTS	4 * *	4 *	4 *

SESSIONS	GN	R	D
	F.(3,215)=23.76 p<.0000	F.(3,70)= NS	F.(3,70)=18.62 p<.0000
	1 2 3 4	1 2 3 4	1 2 3 4
1= 5-6 Y.O.	1	1	1
2= 9-10 Y.O.	2 *	2	2 *
3= 14-15 Y.O.	3 *	3	3 * *
4= ADULTS	4 *	4	4 * *

TABLE 42 : MTL : ANOVA (age) and Newman-Keuls test for each experimental group, in each session, and for each matrix type, in the first session.